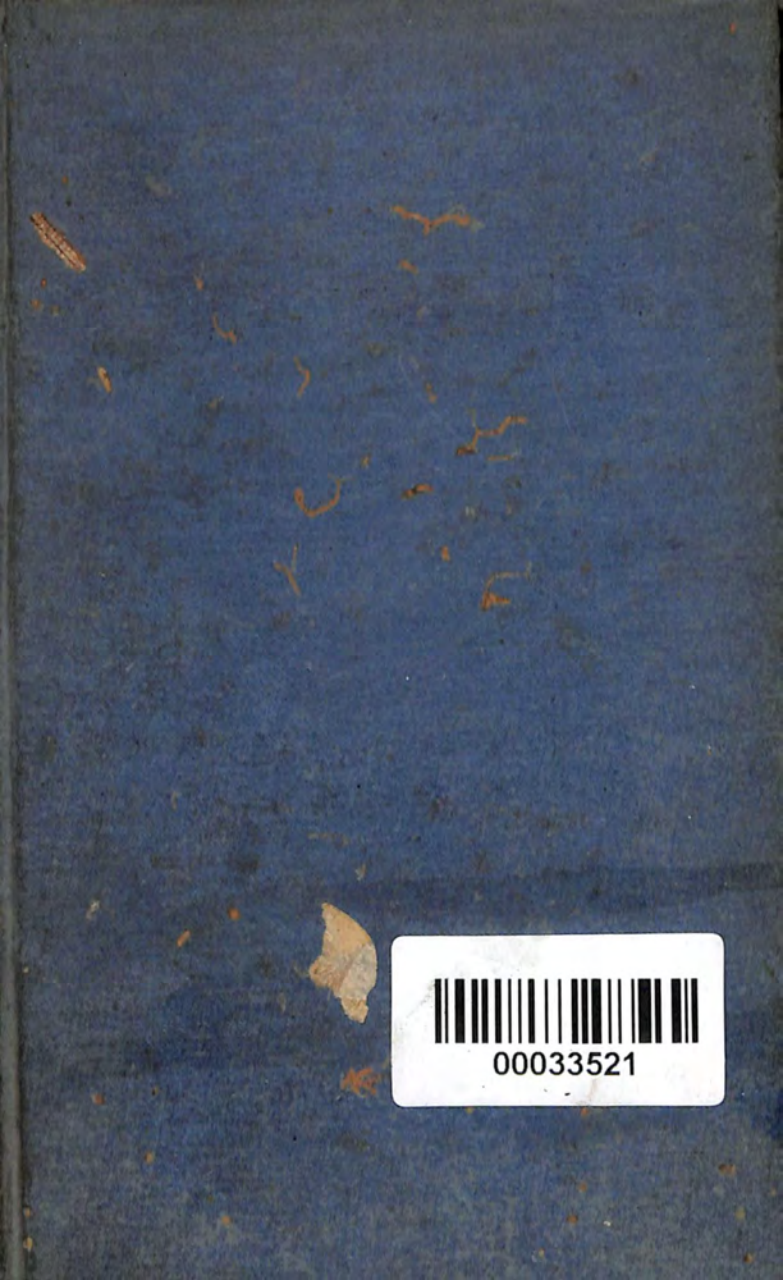
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Sea Anemones.

TENBY:

A SEA-SIDE HOLIDAY.

33521

BY

PHILIP HENRY GOSSE, A.L.S.

"Philosophy, baptized
In the pure fountain of eternal love,
Has eyes indeed; and, viewing all she sees
As meant to indicate a God to man,
Gives *Him* his praise, and forfeits not *her own*."

COWPER.

LONDON:
JOHN VAN VOORST, PATERNOSTER ROW.
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PREFACE.

THIS volume contains a detailed record of a summer holiday spent at Tenby. Nearly every day's occupation is set down, just as it occurred; tide-pool explorations, cavern searchings, microscopic examinations, scenery huntings, road-side pryings,—here they all are; a faithful narrative of how the Author was engaged for about six weeks at that pleasant little watering-place.

Although, in common with some other of the Author's published works, the following pages are mainly occupied with Marine Natural History, he does not fear that those who have already honoured him with their attention, will be displeased to renew their acquaintance with the subject. He ventures to believe that the aspects of nature presented here are in no degree less interesting, less fresh, or less instructive, than those which he has before essayed to unveil. If they do fail to charm, the fault is surely not in *them*, but in him who seeks to minister to others the delight he himself has in contemplating them. He hopes, however, that the approbation so kindly bestowed on his former works will be

continued to this, and that it may be accepted as another Lesson in the important art of "How and What to Observe."

The subject has been thrown into the form of a series of Letters. This admits of a certain ease and freedom, by which the author is (or seems to be) brought into more direct and individual communication with every one of his readers. The earlier ones of the series were actually written on the spot, and sent, just as they now appear, to an esteemed relative in London: and it was afterwards thought well to continue the arrangement, in making up the book for the press. The epistolary form is not very prominent, however; and if any reader dislike it, let him but consider the Letters as Chapters, and he will scarcely be conscious of the difference.

The Illustrations, twenty-four in number, coloured after nature, represent the most interesting of the animals described in the text. With the exception of two plates, containing ten figures of Sea-Anemones, and a third devoted to our largest native Medusa, they all represent microscopic forms.

London,
March, 1856.

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TENBY.

LETTER I.

LONDON TO TENBY.

Natural Objects different in diverse Localities—Causes of peculiar Fertility obscure—Praise of Tenby—Railway travelling—Scenery around Brimscomb—Stroud—Anecdote of Napoleon I.—Chepstow—Vale of Neath—The Gnoll—Copper Smoke—Hills of Slag—Tipping—Llanstephan—Narberth Road—Rival Benjamins—Coaching—Summer Evening—Welsh Women—Narberth Castle—Hedge-flowers—Birds—Triumphal Entry—First Taste of Tenby.

TENBY, June 22d, 1854.

DEAR E——. Your late remark is doubtless just, that a personal examination of natural objects, instituted in different localities (the more remote from each other, perhaps, the better), does far more to improve true science than the reading of the most voluminous technical books, and is essential to the formation of an accomplished naturalist. Linnæus, I think, somewhere observes that twelve degrees of latitude make almost a total change in the fauna of a region: I feel persuaded that one can scarcely examine carefully two spots on our coast-line, as

many miles apart, without finding some marine animals peculiar to each.

Some spots, doubtless, are more than usually favoured; there are places of extraordinary richness and variety in animal life; places that seem to teem with treasures, where the naturalist may gather, in a day's excursion, what in ordinary circumstances he would count a fair harvest for a week. But such spots are rarities, and the causes which concur to produce such a fertility are not easily explained.

Two years and a-half ago, when I was meditating my first descent upon the Devonshire coast, my esteemed friend Mr. Bowerbank,—than whom no higher authority could be cited for aught that concerns marine zoology,—recommended Tenby to me as being "the prince of places for a naturalist." I did not immediately act upon his counsel; but it has always been present to my mind, and I resolved that on the first opportunity the caverns, and coves, and pools of Pembrokeshire should be overhauled.

To our steady-going forefathers, it was an awful transaction in human life to travel some three hundred miles from home; like love, it seemed "res plena timoris;" yet to our little family-party seated this morning around the breakfast-table at Islington, at the usual hour, it appeared nothing extraordinary to contemplate what we have just been doing,—the drinking of a snug cup of tea in this "little England beyond Wales." To be sure, the rushing flight of the express-train, fifty miles an hour, prolonged through half the day, reminded us of the impetuosity of those sidereal motions that astronomers tell us of,

and now and then brought vividly before us our utter helplessness for self-protection, and that there might be but a step, a second, between us and death; but such is the deadening effect of familiarity, that a bit of pretty scenery or the most trifling occurrence puts all such meditations to flight.

You would think me impertinent if I were to dilate on the scenery which a traveller sees on so frequented a line as the Great Western; and yet to traverse in a few hours the whole breadth of England cannot but present much loveliness. I will not dwell on it, however, nor mention anything in particular, till we come to what I thought very striking—the winding wooded valleys and hanging woods skirting the canal close by the side of the rail as we approached Brimscomb. Hence, as we came to Stroud, the houses scattered on the steep hill-sides, and the numbers of factories and mills, had a most singular appearance. The waters of the canals and rivulets, tinged with blue, told of the dyeing celebrity of the place, and gave occasion to one of our party to mention the curious fact, that in the wars of Napoleon I., when British manufactures were strictly prohibited from the Continent, his own legions were clothed in garments actually dyed at Stroud.

The rocky cliffs of Chepstow; the grand isolated masses which rise from the edge of the rails, alternately hiding and revealing the picturesque Wye; the ever-widening Severn, now near, now remote, rapidly bring us to the sea,—an always welcome object. Fair it looked, as its tiny wavelets kissed the green shore, like those of a village pool.

In the vicinity of Neath, we began to feel that we

were in Wales. The Vale of Neath is eminent for beautiful scenery, of which, though we only crossed its mouth, we had a specimen in The Gnoll, a large oblong, isolated hill on our right, covered with wood, with a noble mansion crowning the summit. One of our fellow-travellers told us that it was recently sold for 180,000*l.* To the left was Neath Abbey, a fine ruin. Mists had been accumulating for some time, partially resting on the hills, and veiling them in that indistinctness and haze which, by making them seem more distant than they are, without diminishing their size, increase their grandeur. But from Neath to Swansea a new feature becomes prominent, producing some fine effects to the passing lover of the picturesque, but anything but agreeable, surely, to the residents. One of us remarked the massiveness and density of the clouds which were hanging round the hill-sides, supposing that they were coming in from the sea before the south-west breeze which was blowing; but our new cicerone undeceived us with the curt sentence of one who could speak with authority,—"'Tis all copper smoke!" And presently we saw it pouring forth in thick yellow masses from the shafts of the smelting furnaces, and spreading in wide horizontal layers, like a huge pall, over the earth. The pall of death indeed! for, as our friend informed us, while our own eyes confirmed the fact, the sulphuric acid deposited from these fumes is fatal to vegetation, rendering large tracts barren, bare, and black, and utterly unfit for agriculture. "It is remarkable," said our communicative companion, "that in dry weather the smoke is almost harmless; but when the

atmosphere is damp, and especially in wet weather, the effect is magical. Wherever the smoke is carried by the wind, the face of the ground is blasted as if a sheet of red-hot iron had been passed over it. I have seen a bed of fine rhubarb, after a cloud of copper smoke had swept over it, exactly resembling, in colour and shrivelled appearance, leaves of dried tobacco. Fortunately, the ill effects are soon spent, and do not extend to more than a short distance; the human constitution too is not affected by it, though cattle are much injured." To this last statement, however, there was a *caveat* appended by another passenger; and, in truth, the cadaverous appearance prevalent seemed hardly to bear out the asserted impunity of man.

Whole hills of black coaly-looking material,—"copper slag," or the refuse ore which has yielded its metal to the operation of smelting,—stand frowning around Swansea; the value of land making it worth while to erect scaffolding for the carriage of the substance to the summit of these artificially-formed mounds. "Tipping-ground" is expensive and difficult to obtain; as we glided over the lofty viaduct which crosses Swansea Vale, we saw the process of "tipping" the slag, and the gradual erection of one of these sable hills.

We sped along across the neck of the promontory which terminates in the bold cape called Worms Head, over the Loughor River, whence a fine view was obtained up the Llanelly Vale, and on to Ferryside, where, across a little arm of the sea, one of the inlets which indent the margin of the beautiful Bay of Caermarthen, and the mouth of the River Towy, we

saw the village, most pleasantly situated on the slope of a green hill, and farther on towards the point, the ancient castle, of Llanstephan, a noble ruin crowning the summit of the promontory. Here our intelligent friends left us,—young mechanics apparently, who wore curious high cloth caps, spoke good English, but with a very Welsh intonation, and kept munching enormous flat cakes, like pancakes, but in substance resembling short piecrust. This sort of pastry, which looks by no means despicable, is evidently a staple commodity here.

"Narberth Road and Tenby!" shouts the guard as he runs along the train; and up we jump, snatch up umbrellas, cloaks, and carpet-bags, and hastily get out, glad to escape from our imprisonment, a seven hours' endurance of that renowned prescription, "When taken to be well shaken." The anxiety which one generally feels in a strange place to know how we shall get to our destination, when that destination lies off the main line, was soon relieved; for the difficulty was how to choose between the pretensions of the eager coachmen, who, leaning over, and now and then bursting through, the slender station-wicket, vociferated, gesticulated, and were fain to take the bewildered passengers by storm. Their intense earnestness and rivalry were most laughable. "Coburg, sir?" "White Lion, sir?" "This is the coach for Tenby, sir; the Coburg, sir!" "Here you are, sir! for Tenby, sir! the White Lion, sir!" "This is the best coach, sir! Take your little gentleman for half-price, sir! four shillings each, and only two for him!" "You shall go by the White Lion, sir, for

three shillings a-piece!" Perhaps, as a naturalist, I ought to have given the preference to so unique a zoological curiosity as the White Lion; but I am a loyal man, and so I chose the Coburg.

And so we started; about a dozen of us outside, and half as many within, to say nothing of a pyramid of trunks that crowned the top, on which sprawled a humorous, quick-witted fellow that had managed to build the pile, nor of a lad "Joe," that hung about behind somewhere, none of us knew where exactly, for we only saw him alongside putting on the "shoe" whenever we began to descend one of the steep hills, and taking it off whenever we arrived at the bottom. Our "respected rival" was about as well loaded as ourselves, so that the coachies might have spared their greed.

Off we dashed, four in hand, four capital horses as ever drew a vehicle, and thoroughly subject to the skilful touch of our not unconscious Benjamin. It was a pleasant change from the railway-carriage to the outside of a coach, on a brilliant summer evening, driving up hill and down dell, between hedges green with foliage and perfumed with flowers. The lanes of North Devon came strongly up to remembrance, and we could almost fancy ourselves going along the lovely Score Valley, or down the Slade Road, near Ilfracombe. I felt a choking sensation in my throat, and understood, better than ever I had done before, what Wordsworth meant when he spoke of

"Thoughts that do often lie too deep for tears."

The Welsh women on the road, in their foreign but picturesque attire, dark-blue hose and petticoat, white

flannel shawl, or red and yellow handkerchief, cap and pink ribbons, surmounted by an immense black beaver hat, of that conical shape of military grace that the public were lately but too familiar with, were, however, a new feature. And so were the swine (I hope the fair will pardon the collocation), whose immense lop-ears, of olden breed, caused our hopeful heir-apparent to mistake them for dogs. As we passed through the villages, it was interesting, and somewhat flattering, to see the whole population, big and small, turn out and line the street; for the transit of the Tenby coaches was evidently the Great Exhibition of the day.

The evening sun gleamed faintly but sweetly on the ivy-clad ruin of Narberth Castle, as we wound half round its hill; and made conspicuous a silvery lake-like piece of water in the distant west, which we were told was a branch of Milford Haven. Wayside trees, mostly half-grown oaks and ashes, overarched our heads all along the road, and the hedges were bright with foxgloves, and dog-roses, and campions; but above all predominated the honeysuckles, in extraordinary profusion throughout the way, and that of both the crimson and the yellow varieties. It was decidedly the characteristic flower. And the tiny birds, in spruce plumage, were chirping by hundreds on the fragrant hedgerows, or darting out and in among their bowers:—

> "The smal foules maken melodie
> That slepen alle night with open eye."

Everything rejoiced in the reign of Summer; her dominion at length fully established. Surely she has

opened her queenly court; surely she has been holding her levee this evening! We could echo the charming sonnet of Earl Surrey, in many of its details at least, but without the sad note with which, like the note of a tolling bell, he closes:—

"The soote season that bud and bloome forthe brynge,
With greene hath clad the hill, and eke the vale;
The nightingall, with fethers new, she synge,
The turtle to her mate hath told her tale.
Somer is come; for every spray now springs,
The hart hath hung his old head on the pale,
The buck in brake his winter coat he flynge,
The fishes flete with new repayred scale.
The adder all her slough away she flynge,
The swallow swift pursueth the flies smale,
The busy bee her honey now she minges,
Winter is worne, that was the flouer's bale;
And thus I see among these pleasaunt thynges
Eche care decays, and yet my sorrow sprynge."

The days are at the longest, and the sun was hardly set, when, with an extra flourish of his whip, our Jehu made his triumphal entry into Tenby; and, amidst his admiring townsmen, who thronged to witness the entry with no less curiosity than the villagers had displayed, drew up in front of the hotel. We, however, scarcely saw house or people, for our eyes were enchanted by the noble view that at the same moment burst upon us, of the harbour of Tenby, the Bay of Caermarthen, and the North Cliffs, with the sands at their foot, and a thin muslin cap of mist on their head. It was but a glance that we took, for we were nothing loth to get a comfortable cup of tea at the well-furnished "Coburg."

When we were refreshed, there still remained light

enough to tempt us to a walk. We accordingly sallied forth, looked at several lodgings, selected one that just met our need, as to situation, conveniences, &c., and strolled through the south gate to the sands. The tide was out, enabling us to reach St. Catherine's Island, and to peep through its perforated caves, and to take such a glance at its honeycombed rocks, and dark weedy basins, as was full of promise for to-morrow.

II.

ST. CATHERINE'S.

The South Sands—Garden Adornment—Bathers—Castle Hill—St. Catherine's Island—Perforated Caverns—Steps to the Summit—Ruined Chapel—Commanding Prospect—Tenby—North Cliffs—Caermarthen Bay—Gowerland—Coast of Devon—Lundy—Caldy—Giltar—Recollections and Comparisons—Burnet Moth—Curious Manners of a Rat—Rapid Influx of Tide—Evening at the Caverns—Comic Adventure—Fatal Accident.

June 26th.

FROM our back door we walk through the narrow sandy paths of a little garden, gay with pinks and fuchsias, to the brow of a steep descent, which leads down to the spacious yellow beach of sand—the South Sands. A zigzag path winds down the hill from each garden in the terrace, and is defended by low walls of stone, which have a curious effect from below, from their peculiar ornamentation. They are surmounted by large whelk shells, bleached white by the sun and rain, and set in regular rows close together; while the exterior faces are adorned by loyal devices of V. R., P. A., and P. W., made of the valves of the great spinous cockle, set in cement, with much attention to symmetry. From amidst the whelks springs up the Common Stonecrop, now covered with

dense beds of its starry yellow flowers; and the angles and crevices are gay with the elegant Fumitory, the blue-eyed Germander Speedwell, and its favourite companion, the Scarlet Pimpernel; and disfigured too, I am sorry to add, with more than sufficient of hawkweeds, nettles, and thistles, to serve as a foil to the flowers.

As we stand at the garden edge, a pleasant scene is before us. Below there is a broad expanse of yellow sand, not nearly covered, even at the highest level of spring-tide, and at low water reaching so far out as to allow comfortable and dry access to St. Catherine's Rock, then no more an island.

It is in the middle of the day, when the tide recedes at that hour, and when the wind is moderate, the air warm, and the sun bright, that these sands are seen to advantage. The gay dresses and many-hued parasols of the ladies are dotting them over by scores; little boys and girls are scampering hither and thither, picking up shells and sea-weeds, throwing pebbles into the sea, and flying with affected fear from the advancing wave, or digging with their wooden spades moats and pits in the soft sand, as thoughtless of the next tide which will sweep all their works away, as their elders are of the scythe of Time, who, with like industry, "heap up riches, and know not who shall gather them." In the midst of the crowd stand a dozen of white bathing-machines, and the busy bathing-women—uncouth, uncorsetted figures—in blue serge gowns with a fringe of rags below, are moving to and fro; while far off, within the verge of the breaking sea, the profane eye that dares wander

in that direction, catches a glimpse of one of these brawny priestesses of Neptune offering a sacrifice to her divinity, in the shape of a slender figure with long sable robe and dishevelled hair. We cannot hear the shrieks, but we see with horror the arms dashed up in despair, as the helpless victim is ruthlessly seized and plunged beneath the whelming wave.—We'll look no more; it is too dreadful!

Let us turn from the thalassine immolation to other features of the scene. On the left the sands are bounded by a steep but not inaccessible mass of rock; the Castle Hill, a favourite promenade, crowned by an ancient ivied ruin, of which I may afterwards speak more particularly. The abrupt sides of this hill are rugged and broken; but the rude, angular fragments of rock, and the chasms and clefts, are partly concealed by a drapery of grass, weeds, and bushes, the deep green hues of which harmonize well with the rich tints of the ferruginous stone.

Our garden-hill rises rapidly to the right till it becomes a perpendicular precipice of limestone rock, with a dark cavern at its base, and a high battlemented wall at its summit, the garden wall of the houses that form Lexden Terrace.

I reserve the most important item in the enumeration to the last. The very centre of the picture is filled by an object of great interest to all visitants of Tenby—St. Catherine's Island.

It is an isolated rock of considerable size, and of bold and picturesque outline, springing abruptly from the sand and gravel at the water's edge at low tide, so that while the further extremity is in somewhat

deep water, the nearer end is left quite dry by the recess of even ordinary tides, while low springs permit a ready access to a large portion of its cliffs on both sides. It is an immense block of compact limestone, sinuous in outline, forming deep receding coves and projecting headlands, and split everywhere into fissures, which in many places have been enlarged into caverns. Towards the nearer or western end, either some convulsion of nature, or the wearing action of winds and seas, has entirely perforated the island in several places, so that we can pass quite through from one side to the other.

A winding path of rude steps cut in the rock, aided by natural projections and slopes, leads to the summit. Here there is a short sweet turf, which supports a few sheep; half wild, sure-footed creatures, that run, turn and look, run again, and leap from crag to crag, almost with the agility of the Alpine chamois.

It is one interesting peculiarity in this region of old historic fame, that almost every little knoll, or point, or island-rock, has its ruin. Castles, abbeys, and priories, in mouldering decay, remain everywhere in the Principality to attest the grandeur of the ancient race who inhabited the land chiliads ago, and whose descendants still possess their pristine inheritance. This little rock has its highest point crowned with the grey and lichened walls of an old chapel, once dedicated to the "Saint Catherine" of popish celebrity, after whom the island itself was named.

A fine commanding view is obtained from this spot, both inland and seaward. At the rear, the entire

town of Tenby is seen; the southern terraces and houses just in front, surmounting the rugged cliffs, with flights of steps leading down to the sands, and the ancient wall pierced by the arch of the south gate of the town, and running up the Castle Hill. Over the gate we see the northern terraces crowning another range of cliffs, scarcely less lofty and more beautiful, from the trees and bushes which clothe them to the water's edge. The old church, with a modern but very elegant taper spire, forms a picturesque finish to the town, rising from its centre, the loftiest part, and piercing the sky with its long-drawn point.

All around the prospect is pleasing. Northward and eastward we trace the cliffs projecting in bluffs of stern grandeur, and receding gradually till they run out into the spit of isolated rocks, known as Monk-stone Point. Then follow, much more remote, the hills, chequered with fields, that make the ample sweep of Caermarthen Bay. More and more, as the coast trends to the east, it diminishes and fades into the uniform blue of distance. At length it seems to dwindle to a line, where the Burry estuary cleaves the land; yet here clouds of dense smoke, white in the sunbeams, are conspicuous, and a telescope enables us to see the tall chimneys that indicate the smelting furnaces of Pembrey. After this rises the noble peninsula of Gower, rich in historical associations, and in romantic scenery; and no less interesting from the English character of its inhabitants, who, like the people of this county, have preserved their isolation from their Welsh neighbours for seven hundred years.

Far beyond this, so faint and dim that it can be discerned only in a peculiarly humid condition of the atmosphere, is the coast of Devonshire, about Ilfracombe, and on towards Hartland Point. It would be nothing to most people, but to me it is interesting to gaze upon it, slight and shadowy as its outline is, because it recals the pleasant memories of Ilfracombe.

Lundy, almost as dim, appears like a little cloud on the south-west horizon. This, too, I look on with pleasure, a pleasure in which you can sympathize; for you remember the delightful week we spent together in exploring that singular rocky islet, exactly two years ago, almost to a day.

Well, then our view comes homeward again, and Caldy Island stretches away along the south line, followed by Margaret Island, both of which I hope to tell you more about soon. The latter is shut in by the lofty promontory of Giltar Head with its sands, which—with one interruption, where the coast becomes low, forming Penally Burrows and sinking to a sandy morass—joins the south cliffs of Tenby, whence we set out.

There is much in this little precipitous islet that reminds me of that visit to Lundy, especially the broken shattered fragments of rock that crown the prominences, the appearance of Cyclopean masonry, which the strata assume in places, and the grand views from the summits down into the chasms and gully-like coves. I found too a curious coincidence in several of the spindle-shaped cocoons of the Burnet Moth, formed of a shining yellow papery silk, and bound head and foot to stalks of grass. Don't

you recollect the hundreds of these cocoons that we found in the fields and marshes behind Captain Jack Lee's house, and the pretty moths, sea-green and crimson, that were flying over the grass in the morning sun?

Though a good deal of the surface is covered with great loose stones, there are not wanting pleasant grassy slopes, and secluded dells, which tempt one to lie in idle enjoyment of the warm sun, the odours of the flowers, and the soothing sounds of the surge upon the long sands.

A few evenings ago I was thus reclining on the turf, looking down on the cove that forms the north extremity of the great cavern. Though it was low tide, the sea did not recede sufficiently to admit of any access to the cove from the shore. Presently I saw a large rat come, deliberately foraging, down to the water's edge, peep under every stone, go hither and thither very methodically, pass into the crevices, exploring them in succession; at length he came out of a hole in the rock with some white object in his mouth as big as a walnut, and ran slowly off with it, by a way I had not seen him go before, till I could follow him no longer with my eyes, because of the projections of the precipice. What he could possibly have found I puzzled my brains to guess, but without much satisfaction. He evidently knew what he was about. From his retirement into the cavern, when the sea had quite insulated it, the sagacious little beast had doubtless his retreat in its recesses; far up, of course, out of the reach of the sea, where he would be snugly lodged, when the waves dash and break wildly

through the cave, kindling millions of fitful lamps among the clustering polypes below.

The influx of the tide is very rapid on the sands, and cuts off the communication between the islet and the shore in rather a treacherous fashion. A day or two ago our little Willie was embayed, as he was intent on making a pool with his wooden spade for the reception of a colony of *Purpuræ* that he had gathered from the rocks; and he related very gravely his apprehensions of being drowned, when he had to wade through the water, which was actually over the soles of his shoes!

In the evening we strolled down to look at the place, and were beguiled into staying till it was quite late, by the interest which attached to the coming in of the tide. There was a breeze from the southward, which hove the sea against the opposite entrance of the cavern to that on which we were standing; and the funnel-shaped cliffs on that side concentrated the successive waves, which drove through in a sort of "bore," and covered with turbulent water large tracts, which but a few moments before were dry. We were pushed from stone to stone, and from spot to spot, like a retreating enemy before a successful army; but we lingered, wishing to see the junction of the waters, and the insulation of the rock. It is at this point that the advance is so treacherous. There was an isthmus, of some twenty feet wide, of dry sand, when my wife, who had seen the process before, said, "It will be all over by the time you have counted a hundred." Before I had reached *fifty*, it was a wide wash of water.

A rather comic scene was enacted there a few minutes ago. The rocky steps by which the isle is ascended rise from the sand at this very point. The tide was coming in, but as we had about half an hour to spare, my wife and myself climbed to the top. As we were descending we met three middle-aged ladies, two of them somewhat heavy in person, leisurely mounting the steps, and now and then sitting down to take breath. We reached the bottom, and they the top; but by-and-by, glancing back to the island, lo! there were the three adventurous travellers at the furthest and highest point, just beginning to return, apparently regardless of the tide, which now had but a few minutes to run before the passage would be closed. A couple of lads, hurrying down, warned them of their condition; but they had not made half their way across the isle before we were reminded of the "hundred" count; and presently the sandy drawbridge was pulled up, and Neptune reigned supreme.

The poor ladies bustled down the rugged and perilous steps with unwonted briskness, gazing with rueful eyes at the waves through which their path lay. A crowd of idlers had gathered round, of course, to witness the *dénoûment*, when a lusty bathing-woman came to the rescue, leading the horse of her machine to the foot of the steps. But here a new difficulty arose; the eldest and fattest of the ladies had evidently never committed her person to "the outside of a horse," and could not be persuaded that safety lay in such an expedient. A brief but earnest whisper ensued, and the admiring throng beheld the stout bathing-wench catch up the fat lady, and bear

her portly burden (some ten or twelve stone I should guess) through the billows. The other Europas were content to have the horse for their Jupiter, and thus all once more trod *terra firma*. Gravely, and with averted eyes, they received the congratulations of the merry spectators, probably painfully conscious of some features in the scene, which I must leave to your imagination, but which appeared greatly to tickle the fancy of the crowd.

This little islet, and these shining sands, have, however, witnessed tragic as well as comic scenes. My friend, Mr. Dyster, tells me of a peculiarly sad incident that occurred at this very spot about three years ago. One afternoon, walking along the beach, he heard a scream, which he supposed might proceed from some playing children, who are usually numerous on the sands. He looked towards the sound, but seeing nothing walked on. Presently he turned and looked again. There was a lady running towards him; suspecting something wrong, he hastened to meet her. "Oh, do come!" said she, "here's a man drowning." At the same moment he sees, just off St. Catherine's, a head in the sea, and then an arm thrown wildly upwards.

When he arrived at the spot two men had already stripped, and were swimming off to the drowning man, but he had gone down before they reached him, and all help was vain.

It proved to be a youth of but twenty years, the son of a London clergyman, who had been taking his first, and unhappily his last, bathe. He had but a few moments before posted a letter to his father,

saying how well and happy he felt himself; and by the same post my informant had the mournful task of communicating his untimely death.

Such things now and then bring vividly to our remembrance the solemn words of the stripling shepherd: "As the Lord liveth, and as thy soul liveth, there is but a step between me and death!" And they cogently inculcate on our too heedless hearts the blessedness of having "our life hid with Christ in God," that no accident can ever touch.

III.

THE CAVERNS.

Description of St. Catherine's Caverns—First Cavern—Dog-winkle—Smooth Anemone—Acorn-shells—Shaggy Polypes—Second Cavern—Shaft—Tidepool—Stag's Horn Polype—Snowy-disked Anemone—Sack Sponge—Crumb Sponge—A framed Picture—Third Cavern—Sandy Pools—Algæ—Botryllidæ—Strawberry Ascidian—Mermaids' Gloves—Starfishes—Mussels—Barnacles—Anemones—The Orange-disk—The Orange-tentacled—The Snipe's Feather—Cypress Sertularia—House-Martins—North Cove—Tenby Head—Evening Walk—Rhizostome—Summer Night on the Sea.

June 26th.

THESE three days past I have spent, or at least that portion of each that included the lowest condition of the tide,—in exploring the perforated caverns of St. Catherine's. I have found their zoological riches fully to bear out the laudatory testimony which I have before mentioned to you; indeed, I have not met with any part of our coast which can compare with these caves, in affording a treat to the marine naturalist.

I will endeavour to describe them to you in detail, though you may be sure that it was not until my curiosity was in some degree satiated, that I could make these leisurely notes. However, I think I have pretty well ransacked them by this time, and

rich are the *spolia opima* with which they have replenished my vases.

The tunnels are three in number, all at the western end of the isle, and all following the same general direction, penetrating from south to north. I shall, in describing them, call the south extremity the entrance, and the north the exit.

When the tide has about an hour and a half to fall, we can pass dry-shod round the western point, and find ourselves on a plain of smooth firm sand. The First Cavern yawns before us, narrow and comparatively low, a fissure with perpendicular and parallel sides. We enter, and proceeding a little way, find the course almost cut off by projecting perpendicular groins, leaving only a passage along the left wall, just wide enough to allow a person to glide through. Few persons pass beyond this point, because the narrowest part is occupied by a pool more than knee-deep, which remains always after the tide has receded. If we wade this, however, we come into a wider chamber and emerge.

The sides of this fissure afford plenty of entertainment to the naturalist. The white shells of the Dog-winkle (*Purpura lapillus*) stud the rocky walls both within and without, in hundreds, and multitudes of the elegant vase-like egg capsules of the same species may be seen clustered about. The Smooth Anemone (*Actinia mesembryanthemum*) is also scattered over the bristling points, and adhering to the walls, glossy and plump, like some ripe pulpy fruit, tempting the eye and the mouth. Great tracts are completely covere with Acorn-shells (*Balanus balanoides*), the individual

shells forced by mutual pressure into angular forms, and drawn out to a great length in proportion to their diameter. These are all as still as death now, but on the return of the tide they open their valves, and leap into activity and life. Low down, partly within the water, and partly left dry, the rock, barnacles, and all, are fringed with what look, when out of water, exactly like the wetted matted locks of a white poodle-dog that has just had a bathe. These shaggy locks are by no means attractive in their present appearance; and, characteristic as they are of these caverns, probably few persons are aware either of their nature or of their beauty under other circumstances. They are, however, Hydroid Polypes of exquisite delicacy, principally of the genus *Laomedea*. Two species occur in this and the other caves in profuse abundance, *L. geniculata* and *L. dichotoma;* the former aggregated in the dense shaggy tufts already mentioned, rarely exceeding two inches in length, and for the most part simple or very slightly branched; the latter forming tiny, slender shrubs, greatly branched, but of the most delicate tenuity, and five or six inches in length.

A few yards beyond this fissure is the Second Cavern, one of more pretension. At the entrance it is about twenty-five feet high and ten wide, but the other end is narrower and lower. As soon as you are well within the cave, on looking up you see that the roof is perforate; a narrow shaft or chimney, rugged and irregular, piercing through the solid rock to the air and light above. The lower end of this shaft has several openings into the roof, narrow arches of rock being projected across.

In the middle the cavern dilates, and branches off into a secondary chamber on the east side. Here you mount on a smooth and slippery ledge, and discover a little tide-pool in a rocky basin, so perfectly transparent, and so motionless, that you cannot see the water-line in the dim light; and it is only by putting down your hand to feel, or by reasoning from the appearance of the living contents, that you can persuade yourself it is a pool at all. All round the margins and smooth sides of the basin, under water, grow numerous and fine specimens of the Stag's-horn Sponge-polype (*Alcyonidium hirsutum*). These are so characteristic of the pool, (scarcely another object of any kind being found there, no sea-weeds, nor even a zoophyte, or scarcely one,) and so remarkable, as at once to claim attention. They have much of the aspect of a Sponge, being downy, growing in irregular rounded masses, and of a sub-pellucid yellowish-olive hue; but to the feel the substance is more solid and fleshy, something between jelly and cartilage. It is frequently three or four inches in length, springing from a minute point of attachment, and much branched or lobed, so as to present a close resemblance to a deer's horn. I shall take occasion to speak again of the phenomena which this curious substance presents under closer examination, and of its interesting parasites; I content myself with alluding at present to what may be observed on the spot of its nativity.

In the same side-chamber, but seated in an inner recess still more obscure, is another pool of similar dimensions and character. You must climb to a

higher ledge, and stride over the former pool, in order to examine it, and then you will see nothing until your eyes are accustomed to the darkness, and without bringing your face as close as possible to the unruffled surface of the transparent water. Here I had the pleasure of seeing the Snowy-disked Anemone (*Actinia nivea*), a lovely little species, known to science only by a specimen or two which I found at Torquay, and described in my "Devonshire Coast." These caverns are its favourite home, the metropolis of the species; and though I shall presently allude to it in greater abundance when I come to speak of the third cavern, yet in this little retired rock-basin, not a few of the delicate snowy blossoms are seen starring the interior.

A beautiful Sponge (*Grantia compressa*), resembling a number of small white sacks with open mouths, and with the sides pressed together, occurs here; interesting to the physiologist, as being the species in which Mr. Bowerbank discovered motory cilia, and thus set at rest the question of the animal character of the Sponges. The common Crumb-of-bread Sponge (*Halichondria panicea*) incrusts the rock with its yellow-brown mass, rising into mamillary eminences, miniature volcanoes vomiting forth, not ashes and liquid fire, but jets of water and clouds of fœcal particles. In general, however, the sides of this cavern closely agree with those of the former in the character of their parasitic occupants.

A fine view of the Castle Hill, looking across the cove, is obtained from the interior of this cavern; and one more limited, but perhaps more striking, from

outside the entrance, looking through the perforation. The effect of the sunlight on the verdure of the hill, and on the sparkling sea, is heightened by the obscurity of the archway, like a bright picture set in a deep black frame.

We return by the way we came, in order to enter the Third Cavern from the same side, viz., from the south. We are now near the middle of the island, standing before a perforation far more noble in all respects than the two preceding ones. The entrance is much loftier, wider, and more rugged, irregular, and picturesque. It is flanked by great projections of rough honeycombed rock, that resemble the propylea of some august temple of old Egyptian architecture. We pass into the solemn fane, and find ourselves in a lofty chamber, which an immense rude pillar in the centre divides into a principal and a secondary gallery. Just in front of this column, the roof, which is rudely vaulted, rises to the height (as well as I could estimate it) of about forty feet, and the width of the cavern is about thirty.

We can obtain access to this chamber only at low water of spring-tides, and can enter it with dry feet only when the tides of the full moon give a greater recess; for a large though shallow pool spreads across the whole breadth of the floor, from the entrance to some distance within the interior, the contents of which partly drain off as the tide recedes, so as to allow a steady foot to pass along a rocky ledge, aided by some scattered stones, at the foot of the eastern wall.

The floor of this cavern is not a bed of yellow sand,

as is the case with the others, but rocky, with many loose masses of stone scattered about. Hence the pools, which are merely the hollows in which the sea-water stands after the surrounding parts are left exposed, are more prolific in their animal and vegetable contents. A sandy pool contains little for the naturalist.

This shallow entrance-pool is fringed with great fronds of the Sweet Oar-weed, or, as the fishermen pronounce it, Whur-weed (*Laminaria saccharina*), intermingled with the long green lax threads of *Enteromorpha*, and the thin expansions of the purple-brown *Porphyra*,—that substance, so papery and tender as hardly to bear the most delicate handling, which is stewed and eaten under the name of *laver*. On the less accessible part of the pool—that is, the west side—the cavern-wall overhangs considerably, so as to throw the inferior portions into more than average obscurity. The rock is here studded with many objects of interest. If we lift the lettuce-like leaves of the *Ulva*, that hang in bright-green crumpled masses, and the tufts of glossy dark-red Dulse (*Rhodymenia palmata*), we see the rough rock covered with patches of gaily-coloured *Botryllidæ*, semi-pellucid fleshy agglomerations that look as if spoonfuls of jelly had been dashed against the wall and had congealed as they fell; yet when we look closely at them, the eye is charmed by discovering stars of brilliant hue set in the gelatinous mass, and the mind is still further delighted when the microscope reveals these stars to be systems of animated beings, every ray a tiny Mollusk of complex organization, and the members of every system

arranged in regular order so as to promote the good of the commonwealth.

More numerous than these we find individuals of another genus belonging to the same tribe, the Strawberry Ascidian (*Amaroucium proliferum*). These, in the more remote parts of the cavern, hang down from the lower rocks in great profusion, attracting the eye of the most indifferent beholder by their bright tints, scarlet and orange intermingled with pellucid white, bearing a striking resemblance to a ripe strawberry, if we suppose that fruit to be drawn out in length, and to hang down in a flaccid manner, without a stalk or calyx. These, like the former, consist of groups of individual Mollusks, arranged in systems, all the members of which are organically united into a common vital mass;—a phase of life, which, common as it is among the lower forms of being, can scarcely ever fail to suggest interesting thoughts to the reflecting and philosophic observer.

The fleshy Polypes called Cows' paps, or, more poetically, Mermaids' gloves (*Alcyonium digitatum*), are scarcely less abundant than the Mollusca above-mentioned. I had chiefly been familiar with this as a deep-water form, coming up attached to old oysters and other shells; but here it occurs between tidemarks. I have reason to think that darkness is more essential to its comfort than constant immersion; in other words, that it is more careless of exposure to air than of exposure to light. The size and development of the masses are in proportion to the obscurity of their residence; even in these cavernous recesses we see only half-grown specimens, and those consist-

ing of one, or rarely two lobes. When left by the tide, these hang down to a great length, the base shrunk to a slender, shrivelled, skinny column, with a white fleshy lump at the tip, from which depends a large drop of clear water; but no sooner does the sea return to their level than they retract themselves, their bodies become plump and pellucid by the absorption of the sea-water into their system of aqueducts, and the numerous little pits that had appeared on the surface swell and protrude into transparent star-like polypes, rendering the aspect of the whole as beautiful now as it was before repulsive.

In this pool too, especially in the angles formed by the overhanging walls, and beneath the shelter of the loose masses of rock, may be seen (not always indeed, for they are locomotive and wayward, but pretty constantly) great sprawling Star-fishes or Five-fingers (*Uraster rubens*); perhaps finding an attraction in the myriads of Mussels that almost pave this cavern-floor. These latter form a remarkable feature of the place; they fringe the walls of the cave, and the rocks around up to a certain level; they floor the pools; and they cluster around every stone, being packed so densely that it would not be possible to thrust even the blade of a knife between them, without violence. Thus they form great patches, or rather tracts, of intense blackness, from the general hue of the Mussel-shells; though on a minute examination we can discover many individuals among the sable host, which are beautifully tinted with pellucid olive or golden brown, and painted with radiating bands of purple. They adhere with great force to the rock

and to each other, by means of the silky threads of byssus, which they spin as their mooring cables, and which are capable of resisting a strong pull.

From the groins and angles of the compact rock project many colonies of the large Acorn Barnacle (*Balanus porcatus*). It is a coarse-looking species, of a conical form, about as broad as high—that is, three-fourths of an inch—with the valves stout, firmly cemented together, and much indented with strongly-marked longitudinal furrows, whence the name *porcatus*, "ridged." Some of these have tiny colonies of the smaller and more fragile species (*Balanus balanoides*) clustering upon the valves, and many specimens are shaggy with very fine *Laomedeæ*, growing on them, like pine-forests on an Alpine hill.

The Acorns in general project with the mouth downward, whence they throw out at frequent intervals that exquisite array of many-jointed limbs, which, expanding as it is thrust forth, and then curving downward, acts like an hand of sensitive fingers, or like a living cast-net for the grasping and securing of any minute creatures that may be roving near. Poor unthinking wight! whoever he may be, Infusory, or Annelid, or Cypris, or germ of Sponge, that meets the clutch of those enclosing fingers! The bristles that pass across the interspaces, locking into each other, shut out all chance of escape: the living net is whipped in, the valves close over the orifice, and the ill-fated wretch presently finds himself in the cavernous maw of the hungry Cirriped.

But let us leave the portal, and advance. In the

middle, and at the north end, the boulders and angular masses become larger, and lie about in wilder confusion. Here there are several shallow stony-bottomed pools, in which the detritus produced by the action of the waves upon the stone has accumulated as an impalpable mud, concealing the crevices an cavities. Beautiful Actiniæ inhabit these pools. The Snowy-disk (*A. nivea*) is more abundant than in the second cave; and two lovely new species, the Orange-disk (*A. venusta*) and the Orange-tentacled (*A. aurora*), are equally plentiful; besides which, the bottom is seen, on a careful examination, to be studded with a species, the Snipe's Feather (*A. troglodytes*), which, on account of the mottled colouring of its disk and tentacles, is very apt to be overlooked. We may search with the eye over a pool, and that with some degree of scrutiny, and conclude there is nothing; and yet there may be dozens of *Actiniæ* expanded there. This species occurs by hundreds on the walls and in the pools in this part of the cavern, in company with the two preceding, for all have the same habit,—that of dwelling in minute crevices or cavities in the solid rock, whence only the disk emerges, or at the most surmounts the thin stratum of mud that conceals the rocky bottom of the pool. This habit renders possession of specimens a very difficult matter, from the compact hardness of the limestone, and from their withdrawal out of sight as soon as they are disturbed.

Other species, more familiar to me, occur here also; as the Smooth Anemone (*A. mesembryanthemum*), of both the red and green varieties, but not the spotted,

so far as I have seen; and fine specimens of the Thick-horned (*A. crassicornis*).

These pools are also particularly rich in the Hydroid Polypes. The *Laomedeæ*, already mentioned, are very fine and very profuse; and on the Mussel beds grow many specimens of that very elegant species, *Sertularia cupressina*, from eight inches to a foot in height. The polypidom of this coralline forms a taper pointed spire, the numerous component branches of which are fan-shaped, and arch gracefully downwards, so that the resemblance to a tree of the pine tribe is neither fanciful nor remote.

Many other interesting animals might be enumerated as inhabiting the parts of these caverns that are covered by the periodic tide; for almost every spot so situated is peopled with inhabitants; while far overhead, in the rugged and gnarled roof, another kind of tenants have made their habitations. The House Martins (*Hirundo urbica*) perpetually fly screaming in and out, stemming with difficulty the breeze as it is condensed and concentrated by the funnel-like form of the perforation; emerging from hollows, and vanishing into them, where it may be presumed their nests are placed, secure against all molestation. We have here, doubtless, an example of the sort of situation which this little bird was wont to select for its economy, in remote ages, when no human habitations existed in the country to invite its confidence.

When we come out on the north side, we discover that the direction of this cavern has diverged from that of the others towards the east; and that a great

projection of rock into the sea prevents access hence to the shore, except at very low springs. We are in a small precipitous cove, very rugged and stony, with not a little deposition of mud; but this cove has a character of its own, which I may describe to you, if opportunity serve, in a future letter.

At present we must return as we came, first taking a satiating look at the noble promontory before us, called Tenby Head, which now in the afternoon sun stands out rich and full, just across the cove about a cable's length from us. It is scarcely less beautiful than St. Catherine's itself, its seaward cliffs of rugged limestone, cleft and chasmed, and its summit of turf, having much of the same character; while the ivied ruins of the old strong castle which crowns its height, impart a peculiar interest to it.

It is a favourite promenade; and in these lovely long evenings, the walk which girds its margin, walled up on the cliff side so high as to allow the gaze to go out freely upon the sparkling sea, is thronged with gay visitors. Last evening we joined the crowd, and were strongly reminded of the Capstone, at dear Ilfracombe. The groins and buttresses were limestone instead of grauwacke; but there was the same steep grassy hill on one hand, up which laughing children were climbing, and down which they were rolling, the same precipitous descent on the other, the same expanse of blue sea, and the same familiar flowers and plants,—the tufty Thrift, the close cushions of pink and white Stone-crop, the Bladder-campion among a wilderness of bramble on the cliff's edge, and the dark rigid Samphire on its inaccessible

angles, spangled with the azure Sheep's-bit, as if handfuls of sapphires and turquoises had been scattered there.

Down we gazed on the smooth sea, becoming more and more mirror-like every moment, as the slight afternoon breeze died away into a calm, and allowing us from our vantage-height to see far down into its depths. Presently I was gratified with the sight of one, and then another, of that enormous Medusa, the Great Rhizostome, urging its diagonal course at the shining surface. Its great bluish-white disk, like a globe of fifteen or eighteen inches diameter, moves foremost by alternate contractions and expansions, which remind one of the pulse of an enormous heart, especially as at each stroke a volume of fluid is shot out of the cavity, by the impact of which, on the surrounding water, the huge body is driven vigorously forward. Meanwhile the compound peduncle, with its eight arms, that hang down to the depth of two feet below, is dragged after the disk; its weight and the resistance of the water to its bulk combining to give that slanting direction which this great Medusa always assumes when in motion.

We watched the great unwieldy creatures a long time, even till evening had faded into night, and we were left almost the only lingerers on the hill. But what a night it was! So calm! so balmy! so solemnly still and noiseless! even the wash of the ripple at the foot of the cliff was hushed. There was no moon, but many stars were twinkling and blinking, and in the north-west a strong flush of light filled the sky, which was rapidly creeping along over the north

cliffs towards which we were gazing. Then those cliffs themselves, all distinctness of feature lost in the darkness, stood like a great black wall in front of us, which being reflected in the placid sea, so truly that no difference could be traced between substance and shadow, the dark mass, doubled in height, seemed to rise from a line only a few hundred yards off; and thus everything looked strange, and unnatural, and unrecognisable, although our reason told us the cause.

IV.

THE GREAT RHIZOSTOME.

Importance of Microscopy—The Rhizostome—Description—Umbrella—Peduncle—Arms—Crisped Foliations—Leaves—Peculiarities in the Imbibition of Food—Fishes found in the Peduncle—Generative Organs—Tentacles—Germs—Foliations—Thread-capsules—Eyes—Mucus—Mr. Peach's Observations.

June 29th.

THE most gigantic of all the Medusæ that swim the European seas might seem, at the first glance, a somewhat unsuitable subject for microscopical observations. And yet it is not so; for such is the profundity of the Divine wisdom and skill that has employed itself in all organic being, that even the highest powers of artificial sight will, I am persuaded, leave it still unfathomed. So many of the functions and operations of life are performed by organs of excessive minuteness, even in the largest animals, that many problems in their economy can be solved only by the most delicate microscopical investigation; while our knowledge cannot but be increased by the same powers brought to bear upon the complicated structure of various organic tissues. Thus I hope the following observations, incomplete as they are, may not prove uninteresting to you.

The *Rhizostoma Cuvieri* is probably less generally

distributed around our shores than has been supposed, since Professor Edward Forbes, than whom no higher authority on the subject of Medusæ could be cited, states that he has seldom met with it.* The occurrence of the species, however, is by no means unfrequent at Weymouth, a score of specimens at least having floated into the harbour in the course of last summer; and here I have already seen as many, either swimming at large, or left dry on the sand. One of these Medusæ having been pushed or towed to the quay-steps in front of my lodgings, I was presently invited to secure possession of the prize.

I immediately had a large washing-pan brought down, which we then plunged into the water beneath the Medusa, and lifted out with the unwieldy burden lying reversed in the cavity, and just filling it; the great peduncle hanging helplessly over the side. Thus two persons readily carried it within doors, and deposited it in a large bath, which I had filled with sea-water. Here it could float side-wise, and carry on its pulmonic contractions, though the dimensions of its prison were not sufficient to allow it to turn itself.

The whole height of this specimen (see Plate I.) was about two feet; the umbrella, which was about fifteen inches in diameter, was much more globose than is represented in such published figures as I have seen. A border of about three inches in width is rather abruptly bent downward and inward, and this border freely expands and contracts with the alternate pulsations. The whole of the umbrella is of a consistence almost cartilaginous, or rather resem-

* Naked-Eyed Medusæ, p. 77.

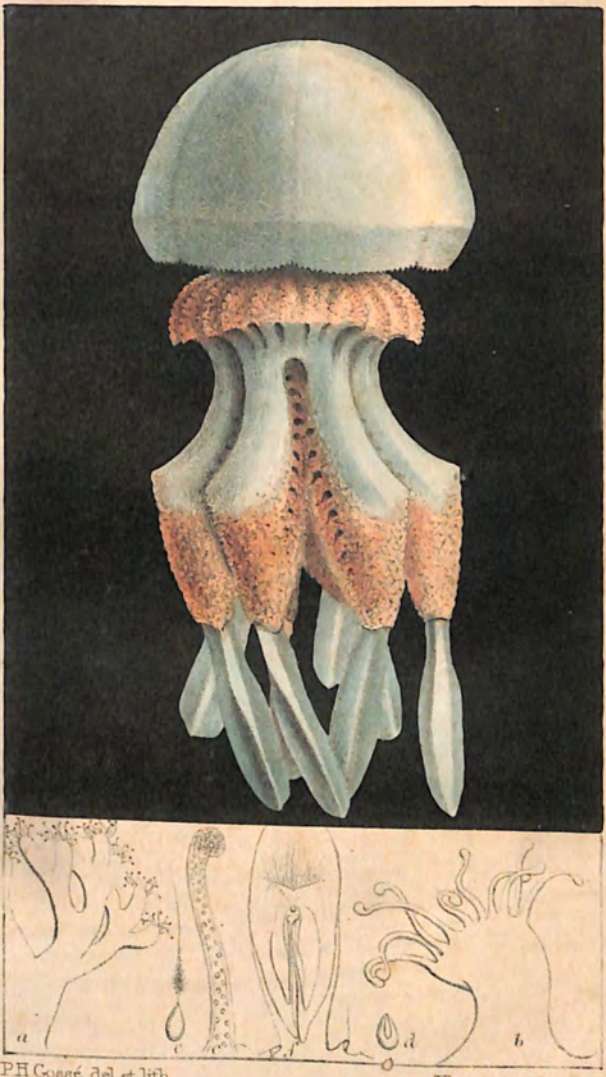
bling in texture the skin of a boiled calf's head when cold; dully pellucid, like ground glass; with a surface minutely granular: its colour a pale greenish blue. Eight radiating vessels are dimly seen through its substance, each terminating close to a marginal eye; the whole edge is cut into scolloped denticulations, about ten in each interspace from eye to eye. A margin of rich dark purple, about one-eighth of an inch in width, borders the whole, following the course of the indentations. The eyes are set in deeper notches, and protected by pointed flaps of the common substance. The sub-umbrella is roughened with close-set corrugations, with radiating interrupted bands.

The peduncle is so wide as to occupy the whole diameter of the umbrella, with the exception of the pulsating margin already mentioned. It forms a nearly square cartilaginous disk, connected with the under-surface of the umbrella at four points of its edge, leaving four oval openings into a great arched cavity. Below, it presently divides into eight arms of a bluish pellucid hue, and of the same firm and cartilage-like substance, so firm as to bear being cut with a knife, and so brittle as to be snapped off on the application of violence. Each of these arms is crowned with an arching summit, divided into two lobes, which lobes are again divided and subdivided; and the extreme edges are contorted and crisped so as to bear no slight resemblance to a head of cauliflower. Below these crowns the arms are smooth for a considerable distance, increasing in thickness to a certain point, where the outline forms an abrupt angle, and thence diminishing to their extremities.

For a space of eight inches below the angle the surface of each arm is covered with close-set, crisped foliations, in all respects resembling those of the arched summit; this structure extends on the inner sides of the arms nearly, if not quite, up to the point of their divarication. Its colour both here and on the arched summits is of a pale salmon-red, or carnation hue, contrasting strongly with the light blue of the other parts.

The crisped structure terminates abruptly, and the arms below it form leaf-like organs, of the common cartilaginous substance, each having a high keel running down its length, like the ridge on the breast-bone of a bird; or so, that a transverse section of the leaf would be tri-radiate. A rather broad vessel is seen running along the centre of each leaf, whence branches proceed, at remote intervals, obliquely towards the margin; before reaching it, however, these send off other branchlets, which again ramify, and meeting those of their fellows, anastomose, so as to form a continuous network of vessels all around the edge of each leaf. A transverse section proved that these *are* vessels, very much flattened. The tips of the leaves in this specimen were ragged as if torn, and one was so small as to convey the impression that it had either been never developed, or had been lost and was in process of restoration.

A careful examination with a power of two hundred diameters revealed no structure in the substance of these leaves, except that minute oval granules (or cavities?) were scattered, moderately thickly, through it; these had an opaque nucleus, and were tailed at



P.H. Gosse del et lith. Vincent Brooks Imp

The Rhizostome

one end; they had no visible connexion with each other or with the vessels, nor, though I made sections in various directions, any regular arrangement. The vessels contained a yellowish granular pulp, somewhat like that which permeates the tubular stem of a Sertularian Zoophyte, but no motion was discernible in its granules.

The high authority of Baron Cuvier, Professor Grant, Mr. Huxley, and others, compels us to believe that the sustentation of this huge Medusa proceeds in a manner so very remote from that of other genera, as the imbibition of microscopically minute organisms by the free terminations of the vessels that permeate the branches, and the transmission of these up the central canals to the stomach. Yet the great bulb at the summit of the peduncle seemed to me not essentially different from that of other Medusæ, the stomach opening by four large transversely-oval orifices, with thickened and rounded cartilaginous edges or lips; while a large globose knob descends from the roof of each cavity. Within these four orifices small fishes are usually found—a circumstance so general, that the children, when they see one of these large Medusæ floating, invariably turn it over to search for the fishes. It has been supposed that the fishes voluntarily resort to these chambers for shelter: but shelter from what? one naturally asks. It is quite possible that they may be attracted into them on some motive or other; but I apprehend that the ulterior object of the ordinance is not the benefit of the fish, but that of the Medusa. I believe it is always found—certainly it was so in the specimen I

am describing—that while some of the fishes are alive, others are dead, and *bearing the appearance of partial digestion.* How can this be accounted for on the supposition of the mouths being situated at the extremities of the leaves? The fishes seem (almost if not quite) always to be of one kind; very young Whiting, about three inches in length.

Viewed from above, four divergent rays are seen, which appear white through the substance of the umbrella, but looked at from below are cream-coloured convoluted membranes. These are the reproductive organs. I cut out portions, and found them to be numerously tenanted by continuous clusters of oval or pear-shaped germs, agglutinated together by their smaller ends, with tubular sacs, closed at the tips, and somewhat resembling the tentacles of an Actinia. These had a sluggish motion, arising doubtless from cilia on their surface, the currents from which were visible. They were swollen in one part, evidently hollow, with thin walls, containing granules. Their length was about $\frac{1}{30}$th of an inch, and their greatest diameter about $\frac{1}{120}$th. These I presume to represent the "generative tentacles" of Mr. Huxley.*

The ova or germs, which were clustered together by myriads in a minutely granulose, almost structureless jelly, had a granular centre, but no bright or defined nucleus; the largest were about $\frac{1}{312}$th of an inch by $\frac{1}{430}$th in respective diameters.

The dendritic salmon-coloured fringes of the peduncle and its divisions presented a very interesting appearance. They resolved themselves into clusters

* Philos. Trans. 1849.

of short branchlets (Plate I. fig. *a*), each of which terminated in a group of about a dozen slender tentacles (*b*) with globose heads, very mobile and active. Each tentacle (*c*) was tubular, with its walls, and especially its globose head, studded densely with those constant weapons of offence, thread-bearing capsules. The latter (*d*) were of a short ovate form, $\frac{1}{1500}$ th of an inch in length, shooting forth a thread to eight times its own length, or about $\frac{1}{600}$th of an inch. *The threads* (*e*) *were invariably furnished* with a dense armature of projecting barbs around their basal moiety. Does not this array of poisoned javelins imply that the prey of this Medusa needs to be rendered powerless before it can be swallowed? And would such a structure be needed for the slaughter of microscopic Infusoria, to be imbibed through the extremities of the peduncular leaves? *

The eyes presented the highly-organized structure usual in the Covered-eyed Medusæ. Each of these organs (*f*) is a gelatinous spherule, of a deep red tint, protected on each side by two pairs of long

* Professor Grant, both by descriptions and figures (Comp. Anat. p. 324), represents the openings of the vessels on the edges of the leaf-like lobes that terminate the branches, to be the mouths which receive the food, and convey it by a perpendicular central canal to a common œsophagus, and so into the digestive cavity. But Professor Huxley (Phil. Trans. 1849) considers the mouths to be pores still more minute, situated at the extremities of the dendritic fringes, overlapped by the clubbed tentacles. Surely organs so very different in structure cannot have the same function. I can much more readily believe the latter conclusion, for the armature of the dendritic extremities is analogous to that of the mouths of the Polypes, whereas the naked and worn tips of the leaf-like lobes seem very unlikely to be mouths.

pendent lobes. When crushed beneath the compressorium, it discharged a multitude of prisms of highly refractile substance, set close together. They were roundish in outline; but on causing some to turn over, to my great astonishment I found them to be really *double-convex lenses*, pretty regular in their curvature, though not accurately so, while there were scattered among them a few straight prismatic spicula.

This animal continually threw off from its surface a mucous slime, which readily diffused itself in the water, and presently made it of the consistence of oil. It did not appear to be viscous or tenacious.

Since the preceding remarks were written, some interesting notes by Mr. Peach have been published, which tend, *tanto quanto*, to invalidate some of my conclusions. They were originally read to the Linnean Society, under the title of "Notes on the Habits of Medusæ and of Small Fishes;" and the following abstract of them has been reported in the scientific journals.

"Mr. Peach's observations were made at Peterhead, in the beginning of August, at which time *Cyanea* [*Aurelia*] *aurita* and *Cyanea capillata* (or *C. inscripta* of Peron?) were so abundant in the harbour and bay as occasionally very much to inconvenience the fishermen, and render it difficult to lift the oars, especially of small boats, from amongst them. Round these Medusæ very small fishes were observed playing, sometimes sporting round *C. aurita*, and quitting it on a sudden for *C. inscripta* when an enemy came near. Occasionally two or three might be seen attending one of the *Cyaneæ*; and when attacked or

alarmed, rushing under its umbrella and among the tentacula, so as to shelter themselves in the large folds connected with the ova, where they remained until the danger had passed, and then emerged again to sport and play around their sheltering friend. When under the umbrella seeking shelter, they lay so close as to allow themselves to be taken into a bucket with the Medusa, from beneath which, after a short time, they would come out and gambol as while in the sea. In this way Mr. Peach captured many young whitings measuring from less than an inch to two and a half inches in length. It was evident that they resorted to the Medusæ for protection, and not, as sometimes stated, that they are preyed upon by these glass-like creatures; and it is probably with a view to greater security that they prefer the stinging species, with its eight bunches of long tentacula and large fringed ovaries, to *Cyanea aurita*, with its single and frequently short row of delicate appendages. 'What, then,' Mr. Peach asks, 'becomes of the paralysing influence of the tentacles of this Medusa on fishes?' This, he thinks, opens a new field for observation. He believes, too, that the facts which he has observed, if not conclusive against, at least throw considerable doubt on, the fish-eating propensities ascribed to the Medusæ; for he is convinced that in these instances the fishes resort to the Medusæ as to protectors, and not enemies. In no instance did he observe a fish in the stomach of the Medusæ, but all were free to depart when they pleased.

In an instance subsequently recorded in his journal, Mr. Peach states that a small whiting, which was

gliding round a small weak *Cyanea aurita*, was attacked by a young pollack, or 'baddock,' whose movements it easily evaded by dodging round the Medusa. A second baddock, however, soon joined in the pursuit; but both were for some time baffled, until an unlucky move drove the whiting from its poor shelter, and then a severe chase took place. The pursuers were joined by others, who followed like a pack of hounds, until the whiting became exhausted, and was left by its enemies, who were unable to swallow it, to all appearance dead. In this state the tide gently drifted it along with the *Cyanea*, until after a time it recovered, swam slowly to its protector, and took refuge as before. The pack soon observed it, drove it again into open water, and this time succeeded in really killing it. During their attack upon it, Mr. Peach repeatedly threw stones among them to induce them to desist; but so intent were they on the pursuit, that they dashed on unheedingly, although at any other time the smallest stone would have alarmed and driven them aside."

Plate I. represents the *Rhizostoma Cuvieri*, reduced to about one-sixth of the natural size. The figures beneath are representations of some of the anatomical details, magnified in different degrees.

a. One of the ramifications of the dendritic fringes.

b. An ultimate branchlet of the same.

c. A single tentacle of the same.

d. A thread-capsule.

e. The same, with its thread discharged, showing the barbed armature.

f. An eye, with its protecting veils.

V.

MONKSTONE.

Boat Excursion to Monkstone—View of Tenby from the North—The Goskar—North Sands—Noctiluca—North Cliffs—Water-winch—Fern Cliff—Tragical Incident—Cormorant's Nest—Blowhole—Foxes—Monkstone—Medusæ—Tepid Pools—Productive Hole—Sea Weeds—Corkscrew Coralline—Bird's-head Organs—Their Use—Sack Sponge—Mr. Bowerbank's Discovery of Cilia—Cluster Sponge—Honeycomb Worm—Its Architecture—Arched Strata of Limestone.

June 30th.

YESTERDAY morning we took advantage of a pleasant cool off-shore breeze, to sail up to Monkstone, a long point of rugged rocks that forms the termination of the North Cliffs, and is a prominent object in the view about a couple of miles to the north-east. The tide was already low, and the harbour dry, so that we were compelled to start from the outer steps; and as we cleared the lofty and massive pier we got a full sight of the town from the northern aspect, and were enabled to appreciate more than we had yet done, its exceeding beauty, crowning the steep and yet wooded heights with its white houses and terraces.

We kept well in-shore, in order to have a more distinct view of the alternate coves and precipitous headlands, first passing the Goskar, a great mass of rock crowned with verdure, that forms a conspi-

cuous object from the town. It is a St. Catherine's in miniature; like it, being insulated at high tide, though now connected with the shore by a narrow belt of sand. The beauty of the sands on both the north and south sides of the town does not fail to elicit our admiration; their great breadth and length, their pure yellow hue, their smoothness, and the lofty precipices of limestone that wall them in behind, render them the glory and the charm of Tenby.

The sea was clear, the sun hot, and I thought that a towing-net might yield me some surface-swimming animals of interest. I accordingly tried it, and obtained an incredible quantity of that curious and interesting animalcule, whose zoological place so puzzles systematists—*Noctiluca miliaris*. Although each animal is not larger than a poppy-seed, there were in the bag of the muslin-net, after a few minutes' towing, as many as would have filled the bowl of a large teaspoon. Individually they seem quite colourless, but when thus accumulated they are seen to be of a pale red, or salmon-hue, and gave out a strong rank odour. This tiny atom is one of the chief causes of the phosphorescence of the sea, which seamen call "brime," and I therefore wished to preserve my prolific dip for observation. In a glass jar of water they all came to the top, crowding together so as to make a sort of scum, layer upon layer, six deep. At night this scum was most vividly luminous, especially on a tap or shake being given to the vessel.*

* In my "Devonshire Coast," p. 253, I have given the results of some observations on this curious animal, and Mr. Huxley and Dr. Webb have since published their researches on it, in the "Journ. of Micr. Science," vol. iii.

We passed indentations of the coast for which the boatmen had no other names than "First Bay" and "Second Bay;" then Bowman's Point projects its rugged front, and we presently open a sweet little cove with a wild glen behind, at the foot of which is a pretty villa called Waterwinch. One is taken by surprise at seeing a dwelling of this character in such a sequestered place; but the beauty of the valley, glowing with the purple-blossomed heath, and gay with many other wild-flowers, justifies the taste of the owner. The cliffs too are highly picturesque; now sheeted with verdure almost to the water's edge, now bold, craggy, and cleft, with yawning caves here and there.

Fern Cliff is of the latter character; it derives its name and a good deal of local celebrity from the casts of fossil ferns which it contains in high perfection, and in such abundance as to be easily procured by the most ungeological virtuosi, whose hammers often batter the rock for its exquisitely pencilled specimens.

The approach of the tide is treacherous here to visitors who are unfamiliar with the place, as the points are impassable except at low water. The boatmen informed us of the melancholy fate of a large family-party here some years ago. They had walked over the sands to Fern Cliff, and made their picnic in a cavern close by, forgetful of the silent march of the tide. When they discovered their isolation, escape was cut off, and the overhanging of the rock forbade all chance of climbing. They were all drowned, and the bodies picked up here and there,

and one by one, as the sea washed them in. The sad story was told as a warning to us.

Now we pass magnificent high precipices with horizontal strata, which we might almost fancy courses of brickwork. Yonder is a Cormorant's nest, a huge bundle of dried sea-weed and coarse grass in a corner of a ledge, and the old bird drops and shoots in a straight line out to sea, keeping just above the surface.

More caves and clefts; but all having, from the direction of the strata here, a peculiar character of squareness, the walls perpendicular, the roof horizontal, as if the mason's tool had been at work. Out of one of the clefts a gush of spray, at every dash of the waves, told that there was a blow-hole or *souffleur* there.

Then we open a little indent, which some of our fair botanical friends here have called Osmunda Cove, because that noblest of our native cryptogamous plants, the Flowering Fern, grows there in great perfection of development. With our boatmen the place had a celebrity in another line of Natural History. "D'ye see that hole, Sir, high up among the rubble? That's the place for a fox! I see five start all at once out of that 'ere hole."

Well, now we are come to Monkstone Point, which is not what it appears from Tenby, a line of stones that a baby might have carried out and placed in a row, but a wilderness of huge angular rocks, tall, vast, and shapeless, that make one think the Titans had been accumulating here the materials for their enterprise. On rounding the point, we found such an

increase of lop as made what our French friends call "the situation" uncomfortable; for the breeze from the north met the swell from the south, and "then came the tug of war." Leaving the combatants to fight it out, we landed on an inviting sandy beach on the north side of the spit, and thus escaped the tumult. Many of the great Medusæ I have already described (*Rhizostoma Cuvieri*) were lying helpless on the strand, to die and dissolve in the sun.

Over slimy weedy boulders we made our toilsome way, and through many shallow sun-warmed pools, in which *Actinia mesembryanthemum*, and its "fidus Achates" the Periwinkle, basked enjoyingly; then, coming to a hiatus in the continuity of the rocky wall, where a majestic pyramid-like mass reared itself, conspicuous even from the town, and now selected by a Cormorant as a watch-tower whence he could reconnoitre the herring-shoals, we crossed over to the opposite side of the spit, alternating between patches of broken rocks and boulders most difficult to traverse, and wide areas of sand delightfully smooth and hard.

Here I left the ladies under the shadow of a great rock, and posted towards the rugged point; for the spring-tide wanted but a few minutes of its lowest range, and as yet I had done nothing. I found many nice deep pools among the broken rocks, and at length saw a very dark one under a great stone, into which I managed, with some crumpling up, to squeeze my body and limbs. Dirty enough it was, as you may suppose; for in such holes the detritus of the rocks always accumulates as a fine impalpable mud, on the

sides and roof, yet Zoophytes and Polyzoa haunt such places, and fine darkness-loving Algæ grow there; and I found in them enough to make amends for a little mud.

The finest of our native Red Sea-weeds, *Delesseria sanguinea*, *D. ruscifolia*, and *Rhodymenia laciniata*, were growing here; the last-named in particular abundance, and the more interesting to me because I had never seen it in a living state before. The specimens were generally small, not exceeding three inches in diameter, but of the most beautiful ruby-colour, and delicately pellucid, though not so thin and muslin-like as *Del. sanguinea*.

The sides and roof of this hollow were fringed with fine tufts of the Cork-screw Coralline (*Cellularia avicularia*), whose curious bird's-head processes excite the wonder of all marine microscopists. No one has yet divined the economy of these most singular organs, which are now found to prevail among the POLYZOA, in one form or other, much more extensively than was once supposed. Several observers have noticed the seizure of small roving animals by these pincer-like beaks; and hence the conclusion is pretty general, that they are in some way connected with the procuring of food. But it seems to have been forgotten, not only that these organs have no power of passing the prey thus seized to the mouth, but also that this latter is situated at the bottom of a funnel of ciliated tentacles, and is calculated to receive only such minute prey as is drawn within the ciliary vortex. I venture to suggest a new explanation. The seizure of a passing animal, and the holding of it in the tenacious grasp

until it dies, may be a means of attracting the proper prey to the vicinity of the mouth. The presence of decomposing animal substance in water invariably attracts crowds of infusory animalcules, which then breed with amazing rapidity, so as to form a cloud of living atoms around the decaying body, quite visible in the aggregate to the unassisted eye; and these remain in the vicinity, playing round and round until the organic matter is quite consumed. Now a tiny Annelid or other animal caught by the bird's-head of a Polyzoan, and tightly held, would presently die; and though in its own substance it would not yield any nutriment to the capturer, yet by becoming the centre of a crowd of busy Infusoria, multitudes of which would constantly be drawn into the tentacular vortex and swallowed, it would be ancillary to its support, and the organ in question would thus play no unimportant part in the economy of the animal.

In the same pool, as well as in others that surround it, were some fine examples of the more delicate Sponges of the genus *Grantia*. Attached to the stems of the slender sea-weeds were some nice specimens of the Sack Sponge (*G. compressa*), a particularly pretty and interesting form, resembling wide bags of a texture like that of white blotting-paper, the bag being apparently squeezed flat, so that two opposite sides are nearly in contact, and each bag having from one to three or four round orifices, seated on prominent angles. Out of these mouths issue during life strong and continuous currents of water, which may be readily seen with a pocket lens in a small Aquarium, and present a most convincing evi-

dence to the observer of the vitality and energy of these seemingly plant-like bodies.

This identical species, as I have already said, enabled Mr. Bowerbank, when visiting this place four years ago, to detect the proximate cause of these currents, which up to that time had been the subject of debate and conjecture.* After many experiments he succeeded, by tearing the little bags across, in seeing that the walls were composed of hexagonal cells, formed by the arrangement of calcareous spicula, each of which, as usual in this genus, consists of three glassy needles radiating from a common point. The interstices of the spicula are filled with gelatinous granules bearing a long whip-like lash, which is waved up and down in the cell with vigour. These vibrations, combined rhythmically with those of many other such *cilia*, produce the strong rush of water which pours out of the orifice.

There occurred also finer examples than I had hitherto seen of the Cluster Sponge (*Gr. botryoides*), some of them an inch and a quarter in height, and about half that diameter. This is also white and papery, and agrees in texture and general structure with the former; but consists of a great number of minute open tubes, simple or branched in various degrees, clustered together. It has been fancifully compared to a bunch of raisins, whence the specific name; but the comparison is far from felicitous. I have elsewhere described the structure of this species in detail,† and therefore shall say no more about it here.

* Trans. Micr. Soc. iii. 137. † Devonshire Coast, 234.

I was amused with the architectural instincts displayed here by a little worm, *Sabellaria alveolata*. The surfaces of the rocks near the low-water verge are covered with rounded masses of what appears to be a very coarse sandy stone, but having so regular an arrangement of sinuous ridges and furrows, as strongly to bring to my mind the brainstones that I had seen on the coral reefs in the Caribbean Sea. On examining these, I perceived that they were composed of an immense aggregation of tubes, set side by side, and one overlapping another, but so that the orifices of all were at the surface of the mass. It was, however, the structure of the tubes themselves that was so admirable. They were made of grains of coarse sand, or rather minute fragments of rock and shell, agglutinated together by an animal secretion in a most exquisite mosaic; not rudely, but so carefully and accurately that the surface was as smooth as was compatible with the nature of the material; while the interior of the tube was perfectly even and lubricous, though the thickness of the walls was scarcely greater than that of a wafer. The mouth of the tube was the crowning effort. All were alike, showing that the little architects wrought by infallible instinct. The extremity of each tube projected a little from the common mass, and over it there was carried out a horizontal portico,—a free lamina of the common mosaic, exquisitely built together, and extending about a quarter of an inch. Each portico or umbrella, which doubtless was intended as a protection to the head of the Worm, when protruded from its tube in its search for prey, was carefully finished, being of a

circular outline, with a sinuosity on each side where it sprang from the tube, perfectly symmetrical, and smoothly even all round the edge.

In captivity I have not been able to see the whole process of construction; but I have seen enough to show that every individual fragment of which the mosaic is composed is gathered and selected by the tentacles, brought to the required spot, and there fastened by the natural glue which is poured forth by proper organs of the animal. The Worm is not remarkable for beauty; its ingenuity is its only recommendation; but this is (I think you will agree with me) something worth recording.

When I had ransacked these interesting sea-chambers, I found time to admire the strange manner in which the limestone strata are contorted here. We had noticed a great curvature in the stratification of some lofty cliffs at the back of what the boatmen call the Second Bay. Here, however, the phenomenon was more marked, though on a smaller scale.

In a great mass of the common limestone, the strata were arched circularly, forming concentric layers, of about ten feet radius. About ninety degrees of the circle were visible in the external strata; the extremities of which entering the ground, the chord of the arch was of course the surface. Twelve such layers were visible, from three to five inches in diameter, besides others less perfect. To the west of this, the undulation is reversed. The whole mass of rock is incurvated more or less; it is separated from the main point, though parallel with it, and the latter presents no trace of curvature that I could perceive.

VI.

NORTH COVE.

North Cove—Animals—Red-noses—Their Appearance—Their Power of Tunneling—Opposing Theories—Anemones—Snipe's Feather—Thick-horn—Plumous—Sea-oak—Its Structure and Reproduction—Virgin Ascidia—Clavelina—Sand Launce—Shanny—Popular Nomenclature—Dictyota—Bryopsis—Levels of Organic Life—Barnacles—Mussels—Sea-weeds—Purples—Polypes and Sponges.

July 1st.

I PROMISED you some notes respecting a wide rocky Cove on the north side of St. Catherine's, to be reached at ordinary tides only by passing through the great cavern which perforates the centre of the Island. It is a beautiful place for Zoophyte-hunting, being studded with pools of various sizes, aspects, and degrees of darkness, and with peaks, and rugged masses and shelving ledges, and overarching cromlechs of rock; and being withal so retired and so difficult of access, that few impertinent idlers find their way thither to interrupt the naturalist in his occupation.

Here, then, we are just emerging from the yawning mouth of the lofty cave behind us, but scarcely yet under the span of the clear blue sky. The black rocks overhang their bases, and their sides are crowded

with the orange-coloured Amaroucia, the pale olive and white Actiniæ, and the shrivelled drab Cows'-paps. From thousands of little holes in the stone project small crimson knobs, which the fishermen felicitously call "Red-noses." You touch one, and instantly it retreats into its hole, shooting at you a little squirt of clear water as it retires; a sort of Parthian warfare —firing as it flies.

But what manner of creature is it at all? Let us take a more careful look at him. Here is one with his crimson nose lolling out a good way: it is a white fleshy proboscis, with only the very tip rosy, where we discern two round orifices; and, looking closer, we see that the proboscis is composed of two parallel fleshy tubes soldered together, as it were, and that they open at the common extremity, side by side. We nip it with our fingers, hoping to drag out the troglodyte to open day. Vain hope! he has slipped through our grasp, and has vanished into his fortress, like his fellows. We must batter down his castle; there is nothing else for it.

Whack! whack! Rap! rap! Bang! bang! goes the hammer with its ringing strokes on the well-beaten head of the steel chisel. How tough and hard this limestone is! Ha! here is a fine fragment! and see, it is pierced through and through with smooth rounded tunnels, just wide enough to admit your little finger. And here lie, all exposed and helpless, the objects of our curiosity. Poor creatures! like the cat in the fable, they have but one shift, one resource: ordinarily that is quite sufficient for their defence; for the strong stone walls which gird them in, when retired,

are an impregnable fortress to every enemy, almost; except man, who fights with hammers and steel chisels,—weapons, which, were a jury of Red-noses to decide, would doubtless be condemned as very unfair and unchivalrous.

Well, here they are! little, stumpy, thick-set bivalve shell-fish, with shells of a dirty whitish hue, or what is known in homely tongue as "whity-brown," rough of surface, and uncouth of form. They are the *Saxicava rugosa*.

You say they are ugly, and are about to throw them away. Stay a moment; I won't say a word for their beauty. A red nose is not generally admired; and as that is certainly their handsomest feature, much cannot be said on this score.

But this homespun gentleman has done what you would find a somewhat hard job. He has dug his own burrow. With no other implements than his own flimsy brittle shell, and his soft fleshy body, he has pierced these cylindrical galleries through this uncommonly hard and solid limestone. "How?" say you. "Who knows?" say I. "The carbonate of lime is dissolved by an acid secreted by the animal," say some. "There is no such acid," replies another; "and if there were, it could not act as a solvent upon substances so diverse as are perforated by these borers. No; it is by the incessant rotation of the animal, whereby the rough shell is made to rasp or file away the stone." But others maintain that the rasping organ is not the shell, but the soft fleshy mouth or foot, which is said to be studded with grains of flint, for the purpose. Others, again,

assert that the ciliary currents of water constantly driven against the solid stone are the only, or at least the primary, agents employed in this apparently more than Herculean labour! After these conflicting opinions, all that we can feel sure of is, that the work is done, somehow.

The abundance of Actiniæ here is something remarkable. Every shallow pool is crowded with them. The pretty variegated disks of *A. troglodytes* are here by hundreds, though perhaps you would gaze intently and not see one. The disk does not rise above the level of the mud; and its elegant pattern of black, white, brown and grey, so attractive when spread out in a saucer of clear water, is scarcely visible at all on the mottled and variegated bottom. But when you have seen one, you presently discern another close to it; then another, and another; nay, even outside the pools, on the wet mud, they are to be seen, not expanded indeed, but in the form of flaccid buttons or nipples, with the speckled tentacles just peeping in the centre.

Great apple-like *Crassicornes* too, and some displaying their magnificent blossoms, are scattered about; and on the rocky walls, and in the tiny hollows no bigger than the palm of one's hand, that hold clear water, are incredible multitudes of the Snowy and Orange-disked species, and also of the Plumous Anemone (*A. dianthus*), white, and yellowish olive. These, it is true, are small specimens, none of them exceeding an inch in height; and in this respect very different from the clusters of noble pillar-like fellows that come up from deep water in Weymouth Bay,

and that are so conspicuous in the Zoological Gardens at the Regent's Park. But still it is a very interesting circumstance to find the species under these conditions; for Dr. Johnston* speaks of its residence in deep water as if it were its invariable, as it is certainly its normal, habit.

The cave-sides are shaggy with dense dripping locks of *Laomedea dichotoma*, which I have spoken of before, and which I only mention again, because they are so characteristic that they force themselves upon our attention. The sprawling olive *Fuci* too have their notched and leathery leaves studded with colonies of the smallest of our Flexible Corallines, the *Sertularia pumila*, which old Ellis calls the Sea-oak. This pigmy species creeps by its root-thread to and fro over the *Fucus*, shooting up little erect stems, not more than half an inch high, with rarely more than eight or ten pairs of cells on each, but occasionally bearing a lateral branch of two or three pairs more.

Examined under a low magnifying power, we see that this slender notched thread consists of a tubular horny transparent stem, alternately swelling and contracting, with a joint at every swelling. To each of two opposite sides of this main stem are attached the cells in pairs, formed of the same transparent substance, but becoming thin and membranous at their tips; they spring from the dilated part just above a joint, and, after running awhile in close contact and parallelism with the stem, diverge abruptly outward, and bend their extreme margin a little upward. The cells themselves are rather narrow tubes, about equal

* Brit. Zooph. i. 234. (2d Edit.)

in diameter from their base to their summit. The individual Polypes expand freely, displaying sixteen tentacles arranged around a conical head of granular flesh, and frequently stretch themselves to a length double that of the cell.

At this season the stems are well furnished with the germ-capsules, which play so important a part in the economy of the animal, and which in this family are so valuable to the systematic naturalist for the aid which they afford in the discrimination of species often closely similar. The capsule here is a transparent pitcher-shaped vessel, with a narrowed but still pretty wide orifice, margined by a very short upright rim: it descends to a point at the bottom, where it springs from a joint of the stem, not in the same plane as the opposite rows of cells. It is of the same horny substance as the cells, but is much larger than they, its length being about equal to that of three cells. We must, however, consider it as a cell, developed in form and dimensions for a peculiar object; viz., the protection of the young animals during their embryonic existence.

I have not had an opportunity of observing the formation of the young in this genus; but from the researches of other naturalists (which I have confirmed in the case of *Campanularia*, and *Laomedea**), it is known that the Polypes, properly so called, which inhabit the opposite cells, are sexless individuals; and that female young ones, of a form totally differing from that of the Polypes, and exactly resembling Medusæ, are developed in the capsules, whence

* See Devonshire Coast, pp. 88, 298.

they issue to commence a free, active, independent life. Hence it is more than doubtful whether we ought not to consider this Medusa-form as the proper condition of the animal, and the fixed Polype-form as the imperfect early stage.

Close to the water's edge, I found here a beautiful specimen of the *Ascidia virginea*. It is a molluscous animal, in form like a little sack, one and a half inch high, standing upright on the rock, to which its base is attached, with the puckered opening (the sack's mouth) at the summit, and another orifice very similar to it on one shoulder. The texture of the bag is tough and leathery, but it is pellucid and crystalline, tinged with pale greenish yellow, and allowing us to discern in the interior the branchial sac occupying the whole breadth of the upper parts, spotted with scarlet, and crossed with broken lines of opaque white. In the lower parts we dimly see the intestine bent in an S-like form, and dark-coloured from the nature of its contents. The animal, though sluggish and almost inanimate, except for the periodical opening and closing of the orifices, is attractive for its beauty, and interesting for its structure. It is more common to obtain this and kindred species from deep water than from the rocky shore; the dredge bringing them up in great variety, attached to stones and shells.

A much greater treasure was an animal of the same order, the *Clavelina lepadiformis*, of which I discovered a group in an obscure hole half filled with water. I will give you a separate note on this little beauty; for I carefully dislodged the whole colony, and carried them home for private exami-

nation. At present, I will merely say that, being as translucent as glass, it is scarcely visible but for certain lines and rings of brilliant white, and some dimly-coloured organs in the clear interior; so that careful searching is needful to find it. The animal was one which I was particularly desirous of procuring, having never seen the species but once, when circumstances prevented my devoting to it more than a moment's attention.

In a broad pool there was a shoal of little fishes, which, from their appearance, I took to be the Sand-launce (*Ammodytes*). They were about four inches long, very slender, and their backs were of a semi-pellucid greenish-blue colour. More I could not see; for they were very shy and alert, keeping in the middle of the pool, or on the farther side, huddling together in a shoal when undisturbed, but darting away in all directions, *sauve qui peut*, whenever alarmed.

Another and smaller pool was tenanted by a fish, which a little urchin, just let loose from the National School on the top of the hill, was industriously endeavouring to capture, for some purpose (not scientific) of his own. The fish, however, did not want to be caught, and would doubtless have maintained its liberty, had not the young rogue snatched off his cloth cap, and, making a net impromptu with it, dipped up the poor fishlet in the greasy cavity. I saw it was a Shanny (*Pholis*), but I always like to learn provincial names of animals.

"What d'ye call it, my lad?" said I.

"John Bull, Sir. Take care; he'll sting!" added

he, evidently confounding it with the little Weever (*Trachinus*), which is not uncommon hereabout. However, I had got a note. "Mem. The Shanny is known on the Welsh coast by the name of John Bull, probably on account of—" &c. &c. But presently another lad catches a *Cottus*, all head and staring prickles, which he brings to me.

"What do you call it, boy?"

"John Bull, Sir." So that I have to make a correction in my note-book, to the intent that the authority of little boys on zoological nomenclature is to be received *cum grano salis*.

I get outside a great mass of rock, and come upon a little circular basin far out, and very low down, fringed with the delicate papery ribbons of *Dictyota dichotoma;* the rich brown of which weed contrasts prettily with the bright grass-green of the waved and wrinkled *Ulva*. The lovely little *Bryopsis plumosa* also, one of the most charming of all our Sea-weeds, when well grown, from its brilliant green colour, and its elegant feather-like manner of ramification, is quite a common tenant of the tiny pools on this side, especially in those which are hollowed out of the wall-like, solid rock of the isle itself. Even those pools which are so high that they can be covered only when the tide approaches the flood, contain this charming plant, as well as those which are lower.

It was interesting to observe how definitely certain levels of the rock were marked by particular tenants, both animal and vegetable. About twenty feet above the lowest level of the tide (at least, of such spring-tides as we have now), there commences the region

of Barnacles, with a clearly-marked definite line, visible, as far as the rock can be seen, by its umber-brown hue. This extends down to within ten feet of the water's edge; so that the band is about ten feet wide. Then a band of the deepest black extends to the water, which is formed of a layer of small Mussels, wedged together as close as they can lie. In the Barnacle region there are no sea-weeds, but stunted *Enteromorphæ*. In the Mussel region tufts of *Rhodomela subfusca* are abundant, interspersed with great lettuce-like leaves of *Ulva*, and with hanging fronds of *Fucus serratus;* beneath the shadow of which flourish cushion-like masses of *Chylocladia articulata*, their short stems resembling little chains of bladders, and growing so densely that they would look like moss, but for their bright crimson hue. The central part of the whole region is the pasture-ground of the Purples (*Purpura lapillus*), whose massive white shells may be seen stuck over the Mussels and the Barnacles, from about the middle line of the one to the middle line of the other. The lower half of the Mussel region is not exclusively confined to them, being shared with the *Actiniæ*, the *Amaroucia*, the *Alcyonia*, and the scarlet and yellow Sponges, that I have already mentioned; but these chiefly occur in the more shadowed situations.

VII.

TO HEAN CASTLE.

Nondescript Weather—Yea and Nay—Scotsborough—Trefloyne—Legends—The Wreckers—Roadside Flowers—Bloody Crane's-bill—Fine Prospect—Saundersfoot—Collieries—Hean Castle—Park and Grounds.

July 4th.

Do you know the tantalizing indecision of a cloudy, nondescript sort of morning, when you have made arrangements for an excursion, especially if others are involved? The appointment is to meet at the fork of the road, "provided the weather be tolerable." Well, there is a little gleam of watery sunshine at breakfast. "Oh, it is all right; order the carriage to be at the door at ten." It is half-past nine; the clouds are gathering, and it is dreadfully dark to windward. The carriage is countermanded. It clears off, and the sky looks what weather-diviners call "hard." "Come; it will be nothing after all." Away goes John to order the phaeton; but no sooner is he down the steps, than "patter patter" come the great drops, and he has to return for his umbrella. "Oh, this will never do! The Jacksons won't think of it, of course, in such weather as this. We must give it up." But it is easier to say that than to do it, when the sandwiches are cut and mustarded, and the chicken-pie is in the basket, and Jacky has got his

hat and coat on, and keeps asking, with annoying pertinacity, "When *will* it be fine, Mamma?" Besides, we don't know, after all, what the Jacksons *will* decide. We could give it up for ourselves, but we don't like to disappoint *them*. They are quite as strongly set on going as we are; and whether they will think this mongrel weather that keeps laughing and crying, smiling and frowning, and spitting, by turns, "tolerably fine" or not, we cannot tell. At length we risk it, and start; get thoroughly drenched, and find the Jacksons gave it up. Or else *we* give it up, and presently the weather clears, just too late; and we learn afterwards that our friends who went "wonder that we should have disappointed them, after making the engagement."

Much such an exercise had we to pass through this morning, before we finally set off about noon for Hean Castle. We were, however, fortunate enough to escape with only a sprinkling, though many an anxious glance was cast up at the clouds as we proceeded. Rees, the driver, was polite and communicative, with a legend or a story for every spot, all unasked.

"Do you see that ruined mansion, Sir, to the right among the trees, all covered with ivy? That is Scotsborough, the ancient seat of the famous Ap Rhys. The house is half a mile from Tenby, and he could not always hear the church-bell; so he lined the bell with silver at his own expense, that he might hear when to go to church. The bell now hangs outside the tower at Tenby, and anybody can see that it is lined with silver."

"And what is that other ruin farther off, on the left?"

"That is Trefloyne. The owner kept seven horses saddled night and day, to fly from Oliver Cromwell." *

"But what caused the ruin of these two fine houses?"

"Oh, Sir, that's more than I can tell. There's many fine ancient mansions, in all parts of Wales, that now lie in ruins all under the green ivy: but I have heard say that the two families that inhabited Trefloyne and Scotsborough lived by wrecking. They put false lights on the windmill at the end of the South Cliffs, just over the great cavern called the Lion's Mouth, where they used to store their plunder. This went on well enough for a time; but it was the end of the families, for the only son of one family, and the only daughter of the other, were coming home from abroad, and were wrecked through the false lights; and what is strange, the ship went ashore on the sands just opposite the mouth of the cave."

I vouch not for these traditions; you may search for them in Fenton (and not find them); but I give you them as I heard them, while driving along the pleasant road lined with flowers, that more than

* Our worthy informant was a little within the mark; for according to the Parliamentary chroniclers, "the house of Trellwyn, being besieged and growing desperate of relief, after some battery of it, and forcing of an out-house, was delivered on quarter of life and liberty. There was found there forty good horse, ready saddled and bridled, and one hundred and fifty men." The house was held by the Earl of Carbery for Charles I., who had garrisoned it.

divided my attention. The road had that varied character of hill and dale that is so beautiful—fields and woods on the left, rising ground for the most part on the right, more barren. The Tormentilla scattered its pretty yellow stars on the banks all along; the Elder was flowering abundantly in the hedge; the Foxglove, noble and profuse, fit to make the crest of a knight in the olden time, towered above the humble but lovely Germander Speedwell—or Eyebright, as some call it*—and the glistening Silverweed. The Toadflax, a flower which I much admire, appeared high in the hedges, and the fragrant Lady's-tresses reared their curiously-twisted spike of white blossom by the road-side. Near the spot where a rude bridge over a rushy bog marks the boundary of the parish, I found a botanical treasure, no less than the Bloody Crane's-bill (*Geranium sanguineum*), whose fine crimson purple flower is well worthy of garden cultivation. My botanical friends to whom I afterwards named it, were not aware of its existence around Tenby. Not wishing to have our rare flowers eradicated for the sake of enriching some collector's

* Ebenezer Elliott celebrates the Germander Speedwell under the name of Eyebright, thus:—

"Blue Eyebright! loveliest flower of all that grow
In flower-loved England! Flower whose hedge-side gaze
Is like an infant's! What heart doth not know
Thee, cluster'd smiler of the bank? where plays
The sunbeam with the emerald snake, and strays
The dazzling rill, companion of the road
Which the lone bard most loveth, in the days
When hope and love are young? Oh, come abroad,
Blue Eyebright! and this rill shall woo thee with an ode."

herbarium, I do not choose to indicate the situation more minutely, even to you.

After entering St. Issel's parish, the road descends abruptly; and from the brow of the hill we got a noble prospect of the sweep of Caermarthen Bay and the opposite shore. Amruth Castle, a brown mass of building, was dim in the distance. The woods of Hean Castle occupied the hill in front, and nearer was Coppet Hall Point,—a red rugged bluff, pierced with natural holes and artificial tunnels right through, the latter for the transmission of coal and other fossil productions to Saundersfoot. Far in the distance was a blue peak, in the form of a low cone, rising above the level of the nearer hills; and this our guide informed us was Procella Top, the highest elevation in Pembrokeshire. On the right was a dell, and beyond it a rising hill-side covered with the young plantations of Road-wood, behind which Monkstone Point and the sea opened as we proceeded.

We passed through the little village of Saundersfoot, with its small but strong harbour, built of solid masonry. Several schooners were lying in it, and an air of bustle and trade prevailed, very different from the character of idle Tenby. All around in the country, tall scaffoldings mark the situations of the many collieries; and tram-roads lead from the shafts to the harbour, by which the culm and the anthracite are brought down, and whence they are emptied into the vessels alongside the wharves through large wooden funnels.

After mounting the hill on the farther side of the village, the descent is very fine, through the vistas of

hedge-row trees, with the noble woods and park of Hean Castle on the hill before us. One knows not which to admire most,—the peeps of the distant sweeping shore and sea through the trees, or the sombre shade of the lofty woods through which we were passing, as we approached the castle, where we called. The firs were of great size; then came woods of oak, beech, and ash, and those at length opening to the beautiful gardens and conservatory.

VIII.

THE STAG'S HORN.

The Stag's-horn Polype—Its Form and Appearance—Protrusion of the Tentacles—The Bell—Internal Structure—Singular Appendage—The Eggs—Their spontaneous Movements—A glassy Tree—Its Branches, Flowers, and Fruit—Ciliary Vortices—Contraction—The Vorticella.

July 5th.

I HAVE been examining, much to my gratification, one of those branching Sponge-like creatures that I have before mentioned as occurring abundantly in a dark pool in the Second Cavern. I have called it *Alcyonidium hirsutum;* but in appropriating this name, I am not at all confident, since our specimens do not very accurately agree with the description I find in Dr. Johnston of the species, though they approach more nearly to it than to anything else recorded.

I have before said that the polypidom grows in erect compact masses, from a minute base which is attached to the rock. The mass is not at all constant in form, sometimes being nearly cylindrical, or a very lengthened oval, more frequently flattened, divided into finger-like lobes, or branched, so as to resemble the horn of a deer, whence I have called it the Stag's-horn Polype. This resemblance is increased by its

having a plump fleshy appearance, a yellow-olive hue, and a surface clothed with a short dense pile, like the young horn of a Hart in that growing vascular condition popularly known as "the velvet."

On selecting a small specimen and placing it, with as little disturbance as possible, in a narrow upright glass trough of sea-water, that can be transferred to the stage of the microscope, we at first see nothing on the rough surface of the Sponge-like mass, but some very elegant parasites which are rarely absent, and which I will presently describe. Soon, however, a pellucid membranous tube appears pushing out of the mass by a gradual, though quick, unfolding of its everting walls; a bundle of parallel fibres now protrude from the extremity, which, when they have attained the length of the tube itself, fall open at their tips, and constitute a beautiful bell of sixteen tentacles. Each tentacle now presents the form of ciliation characteristic of the Ascidian Polypes (POLYZOA), consisting of a single series on each lateral edge, so moving that the ciliary wave passes, like dark teeth fast chasing each other, up one side and down the other. (Plate II. fig. *a*.)

No sooner has one bell thus expanded than others on every hand are seen rising and opening in quick succession, until at length they stud the surface as densely as they can stand, looking like the tassels of a fringe, only that they are set in superficial, and not in linear, series.

Just below the bottom of the bell, within the membranous tube, is seen the gullet,—a canal with thick muscular walls, swelling in the middle,—which

P.H.Gosse del. et lith.

Vincent Brooks Imp.

now and then is observed to dilate and contract with a swallowing action, as some minute atom of food, sucked down the ciliary vortex of the bell, passes through the throat, and is hurled along this œsophageal canal to the gizzard, whose fibrous walls take the form of longitudinal bands, or perhaps folds, at the lower part of the tube.

Dr. A. Farre, who has so ably investigated the Polypes with ciliated tentacles, describes, as occurring commonly on a species which is either the same as this, or very closely allied to it, a curious object, of which I see no trace in the specimens before me.

"A very singular organ was frequently observed, consisting of a little flask-shaped body situated between the base of the two arms, and attached to the tentacular ring by a short peduncle. The cavity in its interior is lined with cilia, which vibrate downwards towards the outer, and upwards towards the inner, side. It has a narrow neck, and a wide mouth, around which a row of delicate cilia are constantly playing. No flow of fluids could ever be detected through it, nor did the use of carmine assist in showing with what parts the cavity in its interior might communicate. From the circumstance that it is more frequently absent than present, it cannot be an organ of vital importance to the animal; and it is too intimately blended with the sides of the tentacula, and too constant in its position, to be regarded as a parasite. Does it indicate a difference of sex?"*

But for Dr. Farre's great knowledge of the lower forms of animal life, which would scarcely leave him

* Phil. Trans. for 1837.

unfamiliar with so common an Infusory, I might venture to suggest that this was only the young condition of some species or other of the *Vorticelladæ;* of which I shall presently have to describe a notable example.

At certain seasons we might find the infant germs of this Polyzoon, which, according to Johnston, are grouped in clusters, of opaque yellowish hue, distinctly visible to the naked eye, scattered over the downy surface. His account of their movements, evidently derived from personal observation, is so pleasing, that though I have not detected the presence of the ova myself, I shall take the liberty of citing it for you.

"The egg is clothed with cilia, of equal size and shape, and all inclined in one direction, moving with a uniformity and quickness which is admirable and very pleasing to the beholder. When the egg is at rest, their velocity is not diminished, excepting at the will, so to speak, of the ovum; for it may be seen to become slower and less constant, to cease entirely for a moment, and again be renewed with its former force. The egg at rest will at once start from its place, and swim about hither and thither, as if it were endowed with volition, turning on its axis frequently, moving sometimes on one side, sometimes on its edge, when the cilia become invisible. I have seen the cilia, when the ovum was at rest, suddenly disappear, withdrawn as it seemed within themselves, and again be quickly protruded. By their motion they drive a current of water over the surface; but this current has certainly not an uninterrupted circular motion:

it is rather a flowing to the surface, and a current from it; or, as Raspail would express it, an inspiration and expiration of water. When lying still, I have seen the eggs exhibit the most unequivocal signs of irritability, contracting and dilating themselves. The ovum appears to be formed of a firm elastic coat or shell, filled with a granular matter."*

The other object which arrested my attention on the surface of the polypidom I might have supposed to have been an integral part of it, had I not been already familiar with similar forms in our fresh waters. A slender conical tree, with a very slight stem and many horizontal branches, the whole bearing a general resemblance in outline to a fir-tree, but made of a transparent colourless substance, like spun glass, rears its elegant form from the body of the Polype mass, sometimes to a height twice as great as that of the expanded Polype-bell. (Plate II. fig. *b*.)

The branches are set on in a spiral order, equidistant from one another. They are themselves spirally branched near the base, the subordinate branchlets carrying small bells shaped like wine-glasses; but on the middle and upper portions of the tree, the branches carry the bells sessile on them, spirally arranged; in every case with a terminal bell.

The bells, as I have intimated, are in the shape of an inverted cone, having a thickened rim, within which is a circle of rotating cilia. These, by their incessant vibration, produce circular currents or vortices, which whirl round and round, over the mouth of

* Brit. Zooph. (2d Edit.), p. 361.

each bell, all the minute floating atoms which are drawn within its force,—a very curious and interesting spectacle to witness under a good microscope.

In the axils of the branches, or rather of some few of them, are seated other bells, of the same essential structure, but of different form, being shaped like globose pitchers, with a small circular mouth, surrounded by a short upright rim; these are also very considerably larger than the ordinary bells of the mimic tree. An observer of playful fancy might imagine that he beholds a tree covered with trumpet-like blossoms instead of leaves, with here and there a ripe pear-shaped fruit.

Besides the ciliary motions of the bells, the whole tree is endowed with a motile power, which it exercises vigorously. Suddenly, while we are gazing at it with all its branches extended, and all its open-mouthed bells expanded, the passing of a vagrant animalcule, or a slight jar on the table, or even the shutting of a door in a distant part of the house, causes the whole array to contract almost to its base, when it slowly rises till it stands as before. In this process of extending itself after contraction, we see very distinctly that the stem itself is bent in a spiral manner, though, when fully extended, this is scarcely perceptible. The contraction which we saw, and which was too rapid to be followed by the eye, is thus seen to be exactly the same as that which would ensue if we were forcibly to pull out a spiral steel spring till it was almost straight, and then suddenly let it go. It would instantly fly back to its close spiral form, just as the little tree contracts; while the

forcible straightening of the spring would well represent the more slow spontaneous extension.

All these circumstances show us that our little elegant tree-like creature is an Infusory of the genus *Zoothamnium;* but of a species which appears to be undescribed by Ehrenberg, and which I shall therefore name *Z. spirale*, and characterise below.*

Most persons who have paid any attention to microscopic observations are familiar with the *Vorticellæ*, bells of gelatinous flesh, set each at the end of a long slender contractile thread, which is continually throwing itself into spiral coils, and stretching itself out again. The *Zoothamnium* is an animal of the same nature; but through the circumstance of its self-division being incomplete, it becomes branched. The muscle which performs the contractile movements is clearly seen, passing down through the middle of the stem, like a thin ribbon, reaching nearly to its base.

Plate II. represents a small portion of the surface of *Alcyonidium hirsutum* (?), much magnified.

a. One of the Polypes expanded.

b. Zoothamnium spirale parasitic on the polypidom.

* *Z. spirale.* Pedicle slender, spirally bent: branches short, neither umbellate nor verticillate, but set spirally on the trunk: bells sessile, spirally arranged, with a terminal one: larger bells few, axillary. Inhabits sea-water.

IX.

HOYLE'S MOUTH.

Hoyle's Mouth—Reputed Subterranean—Traditions—Terrors—Rural Walk—Reeds—Borage—Other Flowers—Birds—Flies—Grace of Wild Plants—Variety in Form of Leaves—Common Flowers—Chaucer's Enthusiasm—The Daisy—The Cavern—Drapery of Verdure—An exploring Visit—Result.

July 6th.

THE people talk a good deal of a curious cavern called Hoyle's Mouth, about which they have some strange notions. It opens at the end of a long limestone hill or range of hills, about a mile inland; and the popular legend is, that it is the termination of a natural subterranean which communicates with the great cave called the Hogan, under Pembroke Castle, some eight miles distant. It was once traversed, they say, by a dog, which, entering at one end, emerged from the other, with all his hair rubbed off! A gentleman is said to have penetrated to a considerable distance, and found "fine rooms." But the vulgar are very averse to exploring even its mouth, on the ostensible ground that a Boar, "a wild pig," dwells there; I fear, however, that there are more unsubstantial terrors in the case.

I walked out to look at it; and if I found no dragons, nor giants, nor "pigs," I enjoyed a most delightful

rural walk. There was not much to be noticed till I had passed Holloway Marsh, where the wind, whistling and whispering among the acres of bending reeds, recalled the asinine fate of the royal fiddler of Phrygia. I say there was not *much;* but the splendid blue of the Borage which grows in large beds by the way-side is always something to be admired, and its rigid transparent hairs and some other peculiarities in its structure make it interesting to a naturalist.

But a little beyond the bridge, we leave the Pembroke Road, and suddenly plunge down into a narrow lane with tall, almost meeting hedges, a perfect wilderness of flowers. There was the crimson Campion, so variable in the size and hue of its blossoms; the coarse blue spikes of Bugle; the Meadow Vetchling trailing about and throwing its racemes of yellow over the brambles; and the Mountain Willow-herb, with its white flowers tipped with pink; and the modest laughing little Forget-me-not, and blushing Dog-roses, and sugary Honeysuckles in profuse luxuriance. There, too, was plenty of Toadflax, but in leaf only, or only just showing the budding spike—a beautiful plant even so; perhaps those that I saw in flower the other day at St. Issel's were prematurely early; and indeed I hope so, for though I think the flower beautiful, I never see it without a painful reminder that "the glorious summer time" is already waning.

Spruce Chaffinches, birds that understand the difficult art of dressing well, are flitting hither and thither; the sweet Skylark is singing all about the sky; and numbers of warblers, more easily heard than

seen, are chirping in the thick hedges,—young birds of the year, I presume, from their pertinacity. Yet theirs is nothing to the pertinacity of the flies, that keep pitching on my face every moment, and when driven from one cheek immediately alight on the other. Pshaw! how annoying they are! Next to poultry, I do think flies are the most impudent of all creatures.

I pass through a gate whose posts are of massive masonry, out of the chinks of which spring many graceful plants,—the Strawberry, the rich and glossy Ivy, the Hart's-tongue, and the Wall and the Black-stalked Spleenworts, festooning the grey and lichened stone; while the Roses trail and hang over all. How much of our sense of beauty is derived from the free and wayward negligence of such plants! The light and feathery sprays of herbage are tossed here and there, or dance up and down in the breeze; while the great variety in the form and tint of the leaves, no less than of the flowers, constantly charms the mind and pleases the taste. How different are the large, glossy, empurpled, heart-shaped leaves of the Black Bryony, from the many-paired, tendriled leaves of the Vetches; and these from the stiff, tall, and narrow blades of the Yellow Iris, the oval spotted leaves of the Orchis, or the much divided irregular ones of the fragrant Meadowsweet! But all these are charming; perhaps most of all the Vetches, whether the handsome pea-like blossom of the Common Vetch, almost worthy of garden culture, or the beautiful crowded racemes of blue and purple flowers of the Tufted Vetch, that are thrown so wildly and profusely over the hedge, and that, I fear, would flourish nowhere else.

"All these are very common flowers." Yes, such as one may see in almost any rural walk. I do not mention them because I think them extraordinary, but because it is these, and such as these, that make up the beauty of nature. My own eye continually rests on them with delight, and my mind lingers on the contemplation of them; and that not at all the less, because I am familiar with them, and have admired them a hundred times before. I can appreciate the technical joy of finding a rarity; but this is a very different thing from the full enjoyment which one receives from the profuse loveliness of nature in the height of summer,—an enjoyment sometimes so overpowering that we feel we must have sympathy with another mind, or we can scarcely bear it.

If I felt that I needed to "cite precedent" for the love of common flowers, I would refer to our Father of Poets, Chaucer, whose love for the Daisy was more like devotion than an ordinary admiration for the beautiful in nature. You remember how simply, yet how touchingly, he describes his early risings to see his favourite flower expand its petals; how he was wont to go "doune on knees" to observe it more closely; with what affection he speaks of the "smale, softe, swete gras;" and how, after lingering there the long summer's day, he reluctantly retired, looking for a renewal of the same delight to-morrow. I must quote the passage in its antique garb.

> "As soon as ever the Sunne ginneth west
> To seen this floure, how it will goe to rest
> For feare of night, so hateth she darknesse.
> Her chere is playnly spred in the brightnesse
> Of the Sunne, for there it will unclose.

. . . . . .

"And doune on knees anon right I me sette,
And as I could this freshe floure I grette,
Kneelynge alway till it unclosed was,
Upon the smale, softe, swete gras,
That was with floures swete embrouded all,
Of soch swetenesse, and soch odour over all,
That for to speak of gomme, herbe, or tree,
Comparison may not ymaked be;
For it surmounteth plainly all odours,
And of riche beaute of floures.

. . . . . .

And leaning on my elbow and my side,
The long day I shope me for to abyde,
For nothing els, and I shal not lie
But for to look upon the daisie,
That well by reason men it calle may
The daisie, or els the eye of the day,
The Emprisse and floure of floures all.
I pray to God that faire mote she fall,
And all that loven floures for her sake.

. . . . . .

When that the Sunne out of the south gan west,
And that this floure gan close, and gan to rest,
For darknes of the night, the which she dred,
Home to mine house full swiftly I me sped,
To gone to rest, and earely for to rise
To seene this floure to sprede, as I devise."

By the aid of the guide-book, and a little verbal direction, I find a certain gate, beyond which is the slope of a hill covered with shrubs and underwood. A tangled grassy path, barely recognisable, winds up, and in a few moments there yawns the Cavern. It is a low vault of somewhat gothic form, dividing within into two gothic arches, much like an old time-worn church. The left arch soon ends; but the right narrows gradually to a hole, through which one might creep; but dark as pitch, of course. The groins and sides of the cave are fresh and green with

the close-adhering drapery of *Marchantia;* and the Hart's-tongue Fern throws out its arching fronds in profusion from the angles of the ground all along the sides as far as the direct light of the sky falls; but ceases at that point. The boundary of the *Marchantia* is perhaps even more distinctly marked. So much is vegetation, and especially its beautiful green hue, dependent on light! The face of the rock around the mouth is festooned luxuriantly with ivy.

In the afternoon Arthur and I determined to explore it, taking with us candles, lucifers, and a ball of twine. The entrance-hall we found seven yards long; then a narrow passage for five yards, at which point the roof closed to a narrow fissure, so that we had to stoop and creep under it. Thence for five yards more we walked upright, crawled a few feet, and opened into an oval chamber three yards long and two wide. At the end of this a hole led off in a direction considerably to the right of the line hitherto followed: it was not more than as high above the floor as our knees, and just wide enough to wriggle through lying along; we did not, however, attempt this. On the right side of the first passage there was a niche or shelf, where Arthur prudently deposited his hat. The roof all along, and the sides partially, were coated with a rough stalactite; the floor was strewn with broken bits of stone, dirty with clay, certainly brought from without, and doubtless by animals running in.

We returned, satisfied at having penetrated about sixty feet by the line, without disproving the alleged permeability.

X.

DREDGING.

Dredging Trip—First Haul—Second—The Bush-back—Two-spotted Sucker—Wrinkled Sertularia—Beautiful Sea-slug—Habits of Nudibranchs—Thread-cells—Feathery Polype—Its Structure—Root-thread—Cells—Vesicles—Circulation—Core—Polype-head—Tentacles—Thread-cells—Poison—Pigmy Ascidia—Its Eggs.

July 8th.

My esteemed friend Mr. Dyster accompanied me yesterday afternoon on a little dredging excursion between Tenby and Caldy. It was about high water, quite calm, with some swell, and a burning sun. We first threw down the dredge a little to the south of St. Catherine's, in eight fathoms, over a bottom of old shells and shingle. We brought up a number of the Purple-tipped Urchin (*Echinus miliaris*), a specimen of the Lesser Sand-star (*Ophiura albida*), two specimens of a Swimming Crab (*Portunus*), several of the Common Shrimp (*Crangon vulgaris*), and the beautifully-marked "Sea-shrimp," or Scarlet-lined Prawn (*Pandalus annulicornis*).

All of these, with some trifles of less note, were transferred to our pans and jars for future examination; and our men pulled out a little to avoid the force of the tide, which was now setting strongly towards the Sound. About midway between Tenby

and Ord Point, we got another haul; of which the most interesting product was that exquisite Nudibranch Mollusk, *Dendronotus arborescens*, which I now saw for the first time. There was also my little familiar Weymouth friend, the Two-spotted Sucking-fish (*Lepidogaster bimaculatus*), with a layer of its bead-like eggs studding the interior of an old cockle-shell, from which the tiny gemmeous-eyed fry were issuing fast.

A third haul nearer Caldy gave us several more of the *Dendronotus*, and also a tuft of that interesting zoophyte *Sertularia polyzonias*, with many vesicles. This was pronounced by Mr. Dyster to be the finest specimen of this species he had ever seen, though he has been for years paying special attention to the *Hydroids*.

A pair of Latin names conveys but a poor idea to an uninitiated reader; and, therefore, it may not be out of place if I describe a little in detail what sort of creatures these were that our greedy eyes so revelled upon, as, passing the bottle from hand to hand in turn, we gazed through our pocket-lenses, with frequent exclamations of delight, and appeals to each other's sympathy,—"Do just look at that!"

First, then, let us look at the *Dendronotus*. If I call it a slug, I hope you will not take a prejudice against it, as if it were anything like the slimy grey pests that put you so out of all patience when you walk along your flower-beds on a spring morning. It is, however, a slug-like animal, of elegant taper form, almost linear, with the head protected by an expansion, from the margin of which radiate a

number of little branched processes that look like tiny trees. Just behind this "veil," as it is called, there stand up from the back two hollow fleshy pillars, each of which has its orifice adorned with a sort of expanded frill of similar shrub-like filaments; while from the hollows protrude tentacles of elaborate structure, each consisting of a swelling pillar, the sides of which are beset with a number of sloping but parallel narrow plates or ridges set on edgewise. All down the back, running in two rows, one on each side, are erect trees (so strangely is this characteristic arborescence repeated over and over again), much branched and re-branched, so that they have been compared to the ramifications of a piece of coral. The colours of this animal are as elegant as its form. It consists of a somewhat pellucid, tremulous flesh, of a very pale yellow tint, streaked and variegated with chestnut-brown in an irregular pattern, the whole studded with opaque white specks. It crawls rapidly about on the slender Sea-weeds, holding fast by its very long and narrow foot, and gliding in and out among the branches with much grace; and its appearance then, especially on some dark purple *Chondrus* or *Rhodomela*, is particularly pleasing.

The whole tribe to which this lovely creature belongs is understood to feed on the animals of the group, of which the one I have next to describe is a representative. The *Eolididæ* are the only animals I know of, that will attack the Zoophytes, which, from the great *Actiniæ* and *Antheæ* down to the *Sertulariæ* and *Corynes*, form their proper prey. The poisonous

missiles of the thread-cells, which distinguish all the Zoophytes, seem to be too formidable for all other predatory animals except these; and it is a very curious fact, and one well worthy of further investigation, that the thread-cells in question are found also in the *Eolides*—a singular exception, I believe, to the law which restricts these organs to the Zoophyta (including the Acalepha). There is no doubt that they do exist in the *Eolides*, though in a strange situation,—the tips of the branchial papillæ. I have from personal observation confirmed the accuracy of Messrs. Alder and Hancock, who first discovered them there: the inquiry I suggest would be, How far the presence of the thread-cells might be connected with the diet of the Mollusk? And whether, seeing the forms of the missile threads vary in different genera of Zoophytes, the forms of the correspondent organs in the papillæ of the *Eolides* would vary, if the latter were fed exclusively first on one, and then on another genus of the former.

The *Sertularia* is one of that tribe of dubious forms, which, resembling feathers, more or less stiff and angular, more or less flexible and plumose, are so often thrown up by the waves among the Sea-weeds, and are always to be seen incorporated with them in those dried-weed baskets which are made up in watering-places and offered for sale. None but a naturalist suspects that they are not as truly marine plants as the Algæ which they accompany, so plant-like is their appearance and manner of growth; and though their whitish colour might induce a passing suspicion of their vegetable character,

a glance at that tuft of *Corallina* by their side, bleached as white as snow, dispels the thought, and confirms your confidence that they are veritable Sea-weeds.

Yet they are as truly animals as you and I; for though we call them Zoophytes,—that is, "animal-plants,"—they have an essentially animal nature, though of a low grade. They have muscular, nervous, circulating, digestive systems, special organs of sense, special weapons of offence—some of these, it is true, not distinctly appreciable to our observations, but inferrible by legitimate deduction from observed phenomena; as when we presume a nervous system from the sensitiveness to touch in the tentacles, from the existence of those most wonderful thread-cells, and from the visual spherules in the medusoids of the *Campanulariadæ*.

A horny tubular fibre, no thicker than sewing cotton, creeps irregularly over a shell or the stem of a Sea-weed, adhering firmly to the surface as it grows. Here and there it shoots up a free branch in an erect position, like a stem of a plant springing from a creeping root. This stem-thread, if examined now with magnifying power, is seen to be jointed, and the joints look as if they had been formed by twisting the thread round and round, while from each joint on alternate sides spring little vase-like buds, which are hollow cells, with a rim cut into four teeth. As the thread grows, it branches, each branch continuing to produce the buds or cells; while in the angles of the branches are occasionally seated vase-like bodies, in shape much like the cells, but greatly superior in

size, and covered with transverse rings or strong wrinkles, whence the name of *polyzonias.*

All this you may see in the sun-dried specimen that you pick up among the refuse weed; for all this is formed of the common horny skin that constitutes the skeleton. But supposing you had taken one of the samples I had just dredged from the sea-floor, and put it, just as it was, in full health and vigour, into a glass box of water, and placed it, as I did, upon the stage of the microscope, you would have seen something more. You would have seen running through the fibrous root-thread, and all up the centre of the slender tubular stem, a clear yellowish granular matter, like a marrow or pith, in which you would have discerned the movement of a fluid, carrying with it many round grains in an irregular and wayward circulation.

This medullary core sends off a branch at every cell, which, passing through its perforated base, expands within the vase-like cavity, and forms a living, active Polype, capable of alternate protrusion far beyond the rim of its dwelling, or of contraction into a shapeless lump down in its bottom. We watch it slowly expanding; a bundle of flexible gelatinous fingers are gradually pushed forth, which, when clear of the horny rim of the cell, stretch out like the spokes of a wheel, radiating horizontally, or bending with a double curve like the branches of a chandelier. These are the tentacles; organs destined to detect, and to seize, and to convey to the mouth, any unfortunate living wight that may incautiously roam too near the perilous star, provided it be small and weak enough

to be arrested and devoured. The body, which is now stretched out to a slender clear thread, full of circulating granules, pouts out a wart-like prominence from the centre of the rays; and here there is an orifice of no particular shape or size, the supple lips which bound it being capable of indefinite expansion to engulf the prey.

If we apply a very high magnifying power to the tentacles, they appear to be set with irregular knobs and prominences, much like a very rough thorn-stick; but this irregularity is dependent on the irregular contraction of the tentacle; for if evenly extended, the prominences are seen to be uniformly placed in rings or annular bands, throughout the length. Each wart contains a thread-cell, of ovate shape, imbedded in the common substance, the extremity pointing obliquely outward, ready, on the stimulus of the animal's consciousness of prey, to shoot forth its missile weapon. For, as I have elsewhere explained, each of these cells contains, while quiescent, a highly elastic wire of excessive tenuity, but of great strength, coiled up on itself, but capable of being projected with great force, by being actually turned inside out. It is a hollow thread; and as it is ejected, the surface which was the interior becomes the exterior; and as this surface in many cases (probably in all, if we were able to detect the structure) is armed with barbs or bristles, and furnished with a subtile poison (manifest by its effects), the flexible javelin proves a formidable and effective weapon of offence, capable of benumbing the vital energies of the animals whose tissues it enters, and of rendering them an unresisting

prey. Thus you see the *Sertularia* is very far from the helpless vegetable those presume it to be who arrange it among their Sea-weeds.

Among the "trifles of less note" brought up by the dredge, I think I ought not to dismiss without notice a pretty, though very common little object. I refer to the Pigmy Ascidia (*Cynthia grossularia*). Its body is hemispherical, adhering by a broad circular base, resembling an Actinia, when closed, so strongly, that it may be readily mistaken for a new species of Sea Anemone, even by those not unfamiliar with marine animals. Its diameter does not often exceed one-third of an inch. The test or exterior skin is leathery, rather roughened on the surface, and in hue varying from a very bright light crimson, or pink, to a dull reddish-drab. The orifices when closed form tiny warts placed on the summit of the button, but not close together; they are protrusile, and open in a square outline, with lips of a brilliant scarlet hue, without any of those coloured specks on the edges that are considered to be eyes.

This attractive little creature is very abundant in a few fathoms' water, usually crowded into groups of a dozen or more, of various sizes, in the interior of old bivalve shells, and occasionally on stones.

Once I had the pleasure of seeing this Ascidia deposit its eggs. I was looking by the aid of a pocket-lens at one in my Aquarium, when I saw a little scarlet speck suddenly shot upwards out of the anal orifice to the height of a couple of inches, and then slowly sink to the bottom, where I found several more already lying scattered.

Under the microscope these proved to be ova, almost globular in form, but a little longer than broad, measuring $\frac{1}{80}$th of an inch in the longer diameter. The shell was glassy and colourless, but a globose mass nearly filled the interior, which was of a rich scarlet.

The *Cynthia* went on depositing from day to day, till upwards of twenty were accumulated around her. They all, however, proved infertile, from some cause or other.

XI.

TENBY HEAD.

Tenby Head—Honeycomb Limestone—Boring Mollusks—Points and Inlets—Daisy Anemones—A well-stocked Hole—Its Contents.

July 9th.

THE point of Tenby Head is very rugged, consisting of bluff cliffs and needle-like peaks of limestone rock, excessively honeycombed, as if it had been excavated by myriads of Stone-boring Mollusca in ancient ages, and had been raised from its then level. For below the tide-mark, it is still so peopled with the living *Saxicavæ;* and there is no perceptible difference between the character of the rock there, and above the reach of the tide, except that in the higher position the breaking away of the surface by the action of the weather has exposed the excavations, giving rise to that configuration which I have called above "honeycombed." This character, combined with the great hardness of the stone, makes it both difficult and hazardous to climb about the points, as falls are almost sure to be severe; while yet it forms a peculiarly favourable *locale* for one who, like me, delights to peep into holes and corners for strange beasts, and slimy, uncouth "creeping things."

The points are intersected by deep inlets, and here and there hollowed into great caverns; so that it is only at spring-tides that we can make our way round to any considerable distance, or explore the best situations.

Some very good specimens of *Actiniæ* occur in the hollows of these rocks. The Daisy Anemone (*Sagartia bellis*), so common on both sides of the Devon coast in the rocky pools and ledges, and at Weymouth in the brackish estuaries, is here one of the rarest species. I had quite written "non est" against its name, till to-day I found it on this point. Peering about, I uncurtained a high but dark basin, much overhung and shaded with *Fucus serratus*, in which were one *bellis* of moderate size, and two others of grand dimensions, as large as the mouth of a tea-cup, and all expanded to the utmost, with disks regularly circular. They were all of the dark-chocolate variety.

In other hollows, mostly small but dark, the other Anemones that are characteristic of St. Catherine's Caves are also common, and often much crowded. There was one hole in particular more than ordinarily rich in these lovely creatures, whose abundance, together with that of other interesting objects, well illustrated a predilection which I have often had occasion to observe — the preference most marine animals have for obscurity.

After scrambling over many of those rough ridges I have spoken of, we come to a perpendicular wall of rock some twenty-five feet high, jutting out from the cliff right across our way; its foot washed by the sea,

which is evidently of considerable depth, its summit tapered to a sharp edge, and the whole side holed, and furrowed, and honeycombed, and covered with barnacles to the very top.

On the south side of this wall, almost at its base, on a rough mass of rock so covered with luxuriant tufts of Dulse (*Rhodymenia palmata*) as to be richly empurpled with it, I found a little basin, somewhat irregular in outline, but rudely oval, about a foot long, eight inches wide, and six inches deep; in other words, about the size of a soup-tureen. It was, like the other, much obscured by overhanging drapery of *Fucus;* but, on lifting this, I was astonished and delighted with the profusion of animal life, whose gay and varied hues gave the tiny area the appearance of an artist's newly-rubbed palette.

Lest I should seem to exaggerate if I reported the contents of this basin from memory, I took the trouble to count the specimens, noting each sort in my pocket-book upon the spot. Their numbers were—nineteen of the brilliant Orange-disk Anemone (*Sagartia venusta*), and twelve of the Snowy (*S. nivea*), all fully blown; besides two large Shore Crabs (*Carcinus mœnas*), a large Shanny (*Blennius pholis*), a *Cynthia*, several *Sabellæ*, a group of *Sabellaria alveolata*, some very fine masses of *Botrylloides*, and many of the Crown Sponge (*Grantia ciliata*).

Nor was this extraordinary pool less rich in its botany than in its zoology. *Chondrus crispus*, finely tipped with steel-blue as usual; the Common Coralline (*Corallina officinalis*), purpling the sides and bottom; some small fronds of *Rhodymenia palmata*, and one or

two tiny ones of *Laminaria saccharina*, which is particularly pretty while it is young, were there, and two others of superior elegance—*Delesseria ruscifolia*, with its oak-like leaves of fine dark crimson, and the pretty rich-green feathers of *Bryopsis plumosa*. Besides all these, there were other plants and animals of less note, which I did not enumerate.

XII.

LAMPHEY AND PEMBROKE.

Treacherous Weather—Coast Views—Inland View—St. Florence—Butterflies—Flowers—Folly's Flower—Lamphey—Beauty of the Palace—Garden—Priest's Chamber—Grand Window—A Shower—Victory of Nature over Art—Dream of the Past—Rainbow—Pembroke—The Castle—The Hogan Cave—Portcullises—Court—Chapel—Confessional—Vault of Torture—Keep—Dungeon—Royal Chamber—Kitchen—Subterranean—Rape of Nesta.

July 10th.

THE morning "promised *faithfully*;" as people say when they mean most *treacherously*. It was as summery as it well could be; the sun shone as sleepily and dimly through the dancing haze as if he felt sure of having it all his own way for at least a week to come: even the butterflies—aye, that most dependable barometer, the Garden-white—fluttered over the cabbages and nettles in careless security. Who could doubt such indications? 'Tis true we had had rather a wet welcome to Wales, and one of us had been heard humming the old Clown's dolorous stave in Shakspeare:—

"For the rain it raineth every day,
Heigh ho! the wind and the rain!"

But as "the longest lane has a turning," and even wet weather does not endure perpetually, so we sagely thought the longer it had lasted the more probability there was of a change; and when the morning smiled so fairly, we believed.

For Lamphey and Pembroke ho! We set off early through a beautiful country varied with hill and vale, over which our elevated road, along the Ridgeway, affords a commanding prospect. On the left we enjoy a wide-spread expanse of sea, with the isles of Caldy and St. Margaret, and the changing headlands of Giltar and Proud Giltar, passing into the smiling cove of Lidstep, with its lofty perpendicular cliffs; all at length shut in, as we recede further from the coast-line, by the most lovely Vale of Jameston, with its peculiarly English character.

The other side presents a prospect almost equally extensive, and still more varied. Yonder, in a beautiful sweep of green chequered land, nestles the tiny hamlet of Gumfreston, the residence of my venerable friend, the Rev. Gilbert Smith, and his amiable family; there its tower rises above a patch of woods, and there are its white farmhouses scattered about. Farther on is the mansion of Ivy Tower in its ample park; and farther still a picturesque village with the pretty name of St. Florence, the houses peeping out from the groves which half conceal them. Arthur suggests that the name probably ought to be "*Semper florens*," and mutters something about how delightful it would be to live and flourish there always himself, with some mythic "Miss Florence" that he wots of.

And there were objects to delight the senses near at hand as well as afar off. How gorgeous were the butterflies that danced over those tall hedges! How rich the deep chestnut of the Peacock, gemmed with its fourfold eyes! How splendid the contrast of velvet black and full scarlet in the Admirable that played before our horse's head! How gaily the tiny Coppers and Blues whirled and frisked, and how they reflected the rays from their wings in their giddy mazes!

The flowers too, the quiet laughing flowers! may I not speak of them again? I will not mention again those which I have enumerated before, though many of them contributed anew to our enjoyment; for who ever tires of beholding flowers?—our native wild flowers especially? There was the Privet in the hedge, where the sea-air could breathe upon it, so myrtle-like both in foliage and blossom. And the Centaury on the bank, with its pretty crown of shining rosy flowers; and spikes of Wild Mignonette by the path-side, tall and majestic, though scentless; and Hyacinths lingering yet in the shaded dells; and the Blue Vetch abundant in hanging clusters over the battlements of the stone fences. In the herbage of the hedge-rows, too, we saw repeatedly that fine and somewhat rare kind of St. John's Wort, the Tutsan, with its spikes of large golden flowers and black berries; and the pretty small species called *pulchrum*:—

> "Hypericum, all bloom, so thick a swarm
> Of flowers, like flies, clothing its slender rods
> That scarce a leaf appears."

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And, finally, there was a still rarer British flower, the Columbine, which we saw growing in several places where it could hardly have been "the outcast of gardens."

Miss Twamley, who is learned in the romance of flowers, tells us that the Columbine is an emblem of folly, in allusion to the form of the nectary, which curls over, like the caps of the ancient jesters, and those which the painters give to Folly. Hear how gracefully she sings of the ubiquity of the type, and of the antitype too:—

"'Tis Folly's flower, that homely one:
That universal guest
Makes every garden but a type
Of every human breast;
For though ye tend both mind and bower,
There's still a nook for Folly's flower."

We get a fine sight of the town and castle of Pembroke, some three miles ahead, and then come to the village of Lamphey. The approach is pretty, through a grove of ash, bordering a dell, with a picturesque craggy well by the side of the road. We turn down a lane from the village, through the grounds; suddenly the magnificent Ruin of the old Palace appears on the right in full beauty. "How beautiful!" burst from us all. We wound round, passing through the garden filled with old fruit-trees, in high bearing. It was interesting to see the trees trained over the walls and towers, whose upper parts were covered with the most luxuriant ivy. One fine pear-tree was twenty-five yards in length, and loaded with fruit.

The gardener, a young man, civil and intelligent,

acted as our cicerone. The gardens are very well kept, and, as I have said, full of fruit of various kinds, all excellent. But the ruins were, of course, the chief object of interest. The halls, and banqueting-rooms, and square towers, and fine windows—all in ruin, but in comparatively good preservation. Notwithstanding the peaceful character of the architecture that was manifest, we could not help noticing the loopholes for defence against surprise, suggestive of the lawlessness that prevailed when this edifice was young. We noticed a square tower, designated the Priest's Chamber, with a roof below the windows, a causeway once to the Red Chamber, another edifice within a wall now. One lofty wall was surmounted with twelve small Saxon arches along its summit—a style of architecture in which, as the gardener said, Bishop Gower delighted.

Perhaps the grandest feature of all was the great window of stone tracery, beautifully preserved, that nearly fills the eastern gable of the great hall or chapel.

While we are admiring these relics of ancient grandeur, a heavy shower lowers. Dark pillars of rain approach majestically from the left; we hurry to seek shelter as we may, for these towers are all roofless now; some of us stand up like statues in niches, and others cower in archways, and two or three mount a narrow spiral staircase of stone, thinking it will be only a few minutes. The rain begins to patter on the ivy like handfuls of gravel, and presently comes down in sheets, lessening only to revive again with fresh fury; while the thunder growls and roars magnificently

around the old walls, as if it had been a raging lion seeking for an entrance. We were imprisoned there for more than an hour, until our limbs were stiff from our cramped positions. Yet there was something in the storm finely in keeping with the scene, increasing the sense of grandeur and of beauty. I saw before me a conflict continually waged; Nature struggling with Art for supremacy. There was the triumph of Art; but it was fast verging into Nature. Art itself was almost become Nature. Those walls, massive as they are, all grey and encrusted, rough and discoloured, resemble the cliffs of yonder shore: the floors are covered with weeds; herbaceous plants spring out of the clefts, and, drooping, hide the stone; and ivy, deeply, glossily green, drapes all. The young verdure and the flowers contrast with the old stones;—youth supplanting age. The very storm that helps the decay of these makes the weeds fresher; and each herb, smiling in the refreshment of the rain-drops, seems to say, "This is a reinforcement for our side!"

Then I pictured to myself that fair St. George's day, when these now silent and mouldering walls were covered with velvet hangings and silken tapestry; and resounded with the relays of trumpets, as the famous Sir Rhys ap Thomas came on a visit of state to the Bishop. I fancied I beheld the portly knight "enrobed in St. George's livery," with a trumpeter before him and a herald of arms, two pages carrying his train, and "a number of choicest gentlemen" following him up yonder walk. The trumpeter sounds a notice of his approach; the huge gates fly open, and here in this noble hall are seen a cluster of prelates,—

the Bishop of St. David's, the Abbot of Tally, and the Prior of Caermarthen, and other dignitaries,—glittering in scarlet stoles and violet capes, waiting to receive their noble guest. With what scrupulous fulness does the painted herald announce the titles of his lord! with how ceremonious compliments does the whole gorgeous company walk round the court! and what a mockery of true worship is the splendid pageant that follows in the chapel; when masses are said from the high altar "for the long lyfe, peace, and prosperitie of the Kynge, and for the rest of St. George's soul, and for hys safe delyveraunce out of purgatorie!" Alas! alas! where is all that pageant now? and where are those that enacted it? All gone! gone! Like the dreamy picture of it which has just fleeted across my fancy! Yet solemn it is to think that *somewhere* they are, every one of them; the mitred prelate, and the menial page, every one is —either in heaven or hell now; every one consciously, vigorously alive, either in bliss or torment; and every one knows that his place is settled unalterably.

The storm had ceased, the zenith was already blue, and in the horizon before us, where the indigo clouds were packing down in dark dense masses, there uprose, spanning our way like a magnificent triumphal arch, that memorial of the ancient covenant, the ever-welcome Bow. "I do set My Bow in the cloud." Most lovely sign of what is most comforting to the fainting heart, conscious of evil desert,—God in covenant showing mercy! Well may creation grow brighter in its beam!

"Up in the gleamy sky
When the shower-cloud floated by,
The Rainbow shone;
And the glad flowers every one
Caught up the pearls the clouds down flung,
And around them the jewel-treasures hung,
That they might be
Deck'd ever yet more radiantly;
To greet the rainbow, gleaming on high,
Bending in grace o'er the showery sky."

The storm had cleared off, and we resumed our carriage to go on to Pembroke. The road presented nothing worthy of note till we got to the town, which seemed a *very* sober rural sort of affair indeed. Having put up, Arthur and I strolled down to the bridge which crosses one of the long inlets of Milford Haven. The tide was out, and the channel of green mud nearly dry was not very attractive. The Castle, however, looked grand from this point; the massiveness of the fine old Keep, towering above all the rest, in particular, was imposing; and I can well imagine, that when the tide fills this broad creek with still water, reflecting the ancient pile, and the trees, and the projecting points, the effect of the view must be greatly heightened.

We walked round the Castle, which is nearly quite insulated by the creek. Beneath it is a great cavern called the Hogan, a natural vault nearly circular, or rather semi-globular, about eighty feet wide by thirty in height, as well as we could judge. The front has been walled up with solid masonry, leaving entrance only through an arched gate, fringed with pellitory. The sides of the cave are ribbed and groined, and

painted with grey-green lichens; hart's tongue ferns droop in tufts from various points of the roof. Several large holes were visible in the sides, but I think none were perforate; there was also a great hollow in the roof, into which I peered to try if I could see any sign of communication with the world above. I saw none, but everything was so dark, I could be sure of nothing. Just within the entrance there is a perpetual dripping, as if you stood under a tree in a heavy shower, and the ground thereabout is covered with beds of soft mosses (*Hypnum* and other kinds) of the most brilliant green, and with the branching leaves of *Marchantia polymorpha*. Altogether I was much interested in this fine cave; and my gratification was only marred by the state of the floor, which is in so disgustingly filthy a condition as to preclude the full examination of it. That a vault like this, alike interesting from its physical character and from its historical associations, should be applied to the very basest of all purposes, is a standing disgrace to the Corporation of Pembroke, and must bring upon them the indignant contempt of every intelligent visitor.

Thence we searched up the old woman on whom now devolves the office of seneschal, and looked into this old remnant of baronial power. Across what was once the moated drawbridge, the grooves of the three portcullises remain; and a hole was pointed out whence molten lead was wont to be poured on the heads of besiegers, in those days of merciful warfare.

We march into the Outer Court. Part of it was originally covered with fortifications; but now it is a grassy area, on which a pea-hen and her chicks are

strutting, and where rabbits run freely to and fro. Around these are the remains, more or less complete, of five watch-towers, and four more have disappeared; they were all connected on the second floor by strong arched passages in the wall.

In one corner we enter the Chapel, at the end of which is a little room, which we were told was the Confessional. In this two pits were discovered a few years ago, one behind the other. The back one had at its bottom three stout bars of iron passing across its length, each bar studded with short sharp perpendicular spikes. The other pit was smaller, and evidently a flue, the furnace of which was under the spiked bars. What deeds of cruelty were wrought here beneath the confessional, shall be declared in that day—"*Dies iræ, dies illa*,"—when in Babylon shall be "found the blood of saints, and of prophets, and of all that were slain upon the earth."

Opposite the confessional is a niche, with a platform in front for candles or incense, reached by winding steps. This was for the image of some saint, doubtless; but a "saint" of another sort than those just alluded to, I ween.

The Keep is a wonderful tower, circular in form, and of great height. The walls are of immense strength, being eighteen feet thick, of solid masonry; so that one marvels not to learn that, when besieged in the Parliamentary war, this tower held out for seventeen days after the castle was taken, and that it surrendered then only by the cutting off of its supply of water. For from hence a staircase led down to the cavern—"the merveyllus vault caullid the Hogan,"

—where was a copious spring of fine fresh water, of which, as it has been since choked up, we could see nothing. Cromwell at length found means to batter down this staircase with his cannon, and the garrison at once surrendered. At least so say the historians; but local tradition affirms that the surrender was even then forestalled by the treason of a menial, who was hanged for his reward. By the way, the old woman strongly affirmed the existence of a subterranean communication between the Hogan and Hoyle's Mouth, near Tenby, which I have already spoken of.

We gazed up with admiration from the floor of this noble Keep, with nothing to interrupt the eye till it rested on the dome; a hundred feet distant, which is still in fine preservation. There is a staircase in the wall to the summit, but the facings of the steps and the central pillar are gone; a rope hangs down in place of the latter, along which you look up through the spire.

We were now led to the Dungeon, which contained several floors for different prisoners. It is a round tower, with a dome; not so perfect as the Keep, but with a staircase in very good preservation. Not long ago the ground-floor was cleared out; but they found a deep below which they could not fathom, as it was choked up by the fallen floors.

Near this was a building of much interest, as having been the room in which Henry VII. was born. It is an oblong chamber, richly ornamented with carved stone-work. Over the ample fireplace is a shield bearing the arms of Henry. A little square niche probably held a crucifix. In the extreme corner is a

small retiring closet, perhaps a dressing-room. There is a tradition that Henry's mother, Margaret Countess of Richmond, was imprisoned in this room.

At the foot of one of the towers, a Kitchen was shown us, a long room gloomy enough, with gothic arched roof. A stone staircase leads from one corner, choked up, which is not allowed to be cleared for fear of injury to the walls. Hence a subterranean exists to St. Nicholas' Priory, beneath the bed of the creek. The woman declared that she herself had explored this, at least as far as the Priory gardens, being able to penetrate no farther because the passage is choked up with ruins.

By this time we had become tired of gloomy vaults and old falling towers, and were nothing loth to come out to the green grass sparkling with the profuse rain-drops, and to the fresh breeze which was fast brushing away the clouds from the bright blue sky. We returned by the same road as we went, admiring, as we passed, some fine effects of the light, which we had not seen before;—Lamphey Church-tower well relieved by a breadth of light behind, between it and the hill, and also the bold and dark clumps of massy trees. Much depends, in the beauty of a scene, on the way in which the light falls on it, with respect to the beholder.

And now that I am at home again, I will tell you a story connected with Pembroke Castle, that I find in my old books. The strong fortress has figured in history many a time, from the period of its erection to its desolation by Cromwell's cannon balls; but there is one episode connected with it so full of romance

that I wonder none of the writers of fiction have pounced upon it. It is the Rape of Nesta, the beautiful Helen of Wales.

THE ABDUCTION OF THE LADY NESTA.

This lady, who seems to have been as frail as fair, was the daughter of Rhys ap Tudor, Prince of South Wales. She became the mistress of Henry I., and "lived with him in his Castel of Cardiff, as a pretended wife;" by him she had one son, Robert Earl of Gloucester, who, as well as his descendants, was famous in history. She then married Gerald de Windsor, governor of Pembroke, and lord of its castle. Her wealth may be inferred from the fact that eight castles, with their domains, were given her by her father as a marriage-dowry; while her beauty was so dazzling that the whole Principality resounded with her praise.

It was at Christmas, in the year 1108, that Cadwgan ap Bleddyn made a great feast at his Castle of Cardigan, inviting, by proclamation of heralds, all the nobles and gentry of Wales. And now the guests are assembled. There is feasting and carousing; there are feats of strength and skill; there are martial sports and exercises, shows and pageants of splendour; there are passages of arms for the hot-blooded youth; there are seats of honour and solemn ceremonies for the old; there are minstrels and rhymers singing their ballads, and bards of renown reciting poems in rivalry of each other, before courts of adjudication regularly constituted, in imitation of

King Arthur's court, on which this festival is modelled. Finally, there are the ladies; and brightest among them all, like the moon among the constellations, sits the lovely Lady Nesta.

Owain ap Cadwgan, the son of the host, had heard of this illustrious beauty, but it was now for the first time that he saw her. His lawless gaze so inflamed his passions that he determined to possess her. Whether he sought her favour and was rejected, or whether he despaired of his own charms, history tells us not; but he had recourse to the force of arms. Whatever her antecedents, the lady appears free from blame in what followed; it was an affair of brutal violence.

It is the dead of the night. Gerald and his fair wife have returned from the festival, and are sleeping calmly in their castle of Pembroke. Suddenly they are awakened by the clang of arms, by the shouts of men, and by the bursting in of the gates. The crackling flames are heard, and streaks of light glimmer through the crevices of the chamber-door. Owain himself is at the door, with his naked sword smeared and spattered with blood, and followed by a band of glaring ruffians, demanding instant admittance. Gerald slips through a window, alone and undressed, at the moment that the door yields to the blows of the assailants; Nesta is in the arms of her brutal ravisher, by whom she is carried off, with her children, to his stronghold.

The end of this violater of the marriage-bond was according to retributive justice. Henry of England proclaimed him an outlaw, offering a great reward

to any one who should "take or kill Owain ap Cadwgan and his father." The latter, however, succeeded in proving his innocence, and the ravisher fled to Ireland, under the protection of King Murcart. But the retribution was only delayed; returning from his sanctuary, he became involved in a quarrel with Gruffydd ap Rhys, the brother of Nesta, and it was while pursuing a party of his opponents, that he was met by Gerald, and was slain by an arrow from his avenging quiver.

The lady subsequently married Stephen, constable of Cardigan. All her children were conspicuous, and some of them illustrious; among the latter was her grandson, Giraldus Cambrensis, the historian of Wales.

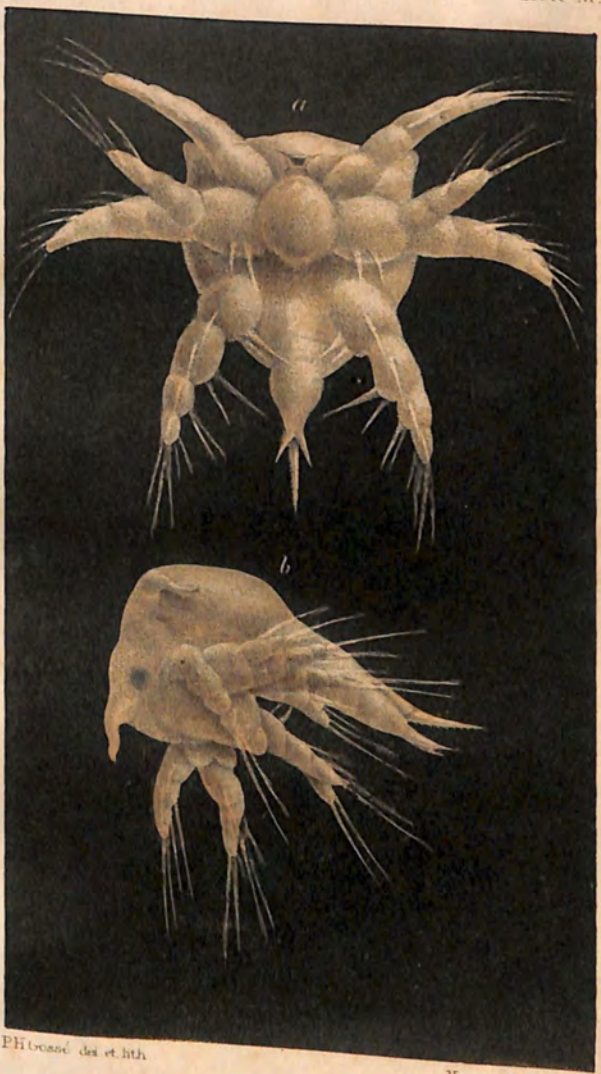
XIII.

CIRRIPED LARVÆ.

Metamorphosis—New-born Acorn-barnacles—Description of them—Their Manners—First Moult—Progress of Development—Second Moult—Further Progress—Representative Forms—Pupa State—Process of Cementing—Appearance of the Adult Form—Tenacity of Life.

July 10th.

FEW subjects in Natural History are more interesting than the metamorphoses which many of the invertebrate animals pass through before they attain their normal condition. With the exception of Insects, whose changes have been known from time immemorial, no animals were recognised as subject to transformation until very recently. There is reason, however, to believe that the law governs nearly the whole of the lower forms of animal life. The great Class of CRUSTACEA, almost without exception, are found to pass through changes not less strange than those of Insects; and their near allies, the CIRRIPEDIA (or Barnacles), are similarly constituted. Mr. Spence Bate, and more recently Mr. Darwin, have thrown a flood of light on the metamorphoses of these, and I have just had the pleasure of confirming some of their observations.



Phitossé del et lith.

Vincent Brooks Imp.

Young Barnacles.

The *Balanus porcatus*, a large and fine species of Acorn Barnacle, with a rugged furrowed shell, is numerous on the rocky walls of the Third Cavern, especially at its entrance. In an earthen pan of sea-water, in which were a few Actiniæ, and three of these large Balani that had been put in the day before, I saw a cloud of dancing atoms, which formed a dense and very compact column, reaching from mid-water to the surface, and there spreading out a little. Their motions were very vivacious, yet they retained their association, and the form of their phalanx, though amounting very probably to many thousands. Under the microscope, they were of the figure of a young Waterflea (*Cyclops*).

I removed almost the whole by one dip of a glass phial, and transferred them to an aquarian vase in the window. Here they congregated, after some time of dispersion, to the side next the light, but did not again unite into a compact body. Their movements were almost incessant, a series of jerking progressions performed by quick but laborious flappings of the limbs, right and left together; in which, as well as in form, they closely resembled the young of *Daphnia*, *Cyclops*, &c. They occasionally lay on their oars, but never alighted, so far as I saw, on any object.

Under the microscope, one presented the appearance delineated in Plate III. figs. *a* and *b*; the former representing the ventral aspect, the latter the lateral, but viewed a little from beneath. The body is enclosed in a broad carapace, shaped much like a heraldic shield, but very convex on the back, and

terminating behind in a slender point or spine, which is cut into minute teeth along its edges. Below this shield is seen the body, with three pairs of legs, a great proboscis in the middle pointing backwards, and the anal fork, which consists of a bulbous base and two diverging points, which project behind under the spine of the shield.

The legs are exclusively swimming organs; they have no provision for grasping, no claws or hooks, nor do they appear to be capable of being used for crawling on the ground or for climbing among the Sea-weeds. They are fringed along one edge with long and stout but somewhat flexible spines, of which those which are nearest the trunk seem more rigid, and are directed more at right angles to the limb, than the rest. The legs are formed of many imperfect joints; and the second and third pairs are double from the basal joint outwards, while the first pair are simple. In the fore part of the body a large eye is placed, deep-seated, which is of a roundish form, and is intensely black both by reflected and transmitted light. On the summit of the forehead are placed a pair of thick flexible horn-like organs, which are abruptly bent in the middle, and which, I believe, represent the first pair of antennæ.

The colour of the little larva is a transparent smoky brown. Its length from the front of the head to the tip of the anal spine was $\frac{1}{95}$th of an inch; its height from the tip of the proboscis to the back, $\frac{1}{175}$th; the breadth of the carapace, $\frac{1}{180}$th.

Three days after these observations, I examined one which had evidently moulted. (See Plate IV. fig. *c*.)

There is an increase in length, but in no other dimension; and this is owing to the development of the terminal spine of the carapace, which is now much produced, and spinulose. The anal fork is also attenuated, produced, and bent abruptly downward at the base, where it is very mobile; a geniculation in the middle throwing the extremity into the horizontal again. The delicately membranous pouch-like proboscis is more clearly seen beneath the breast, the extremity of which is directed backwards. In front of this organ there are two decurved very mobile setæ, set on pedicles, the whole closely resembling the internal antennæ in the higher Crustacea. The lateral horns or external antennæ appear to terminate in a very delicate brush of hairs, which does not seem to be protrusile. The total length is $\frac{1}{10}$th of an inch.

They swim, generally, back downward; though they frequently assume a perpendicular position, both direct and reversed. I see them now occasionally resting on the Sea-weeds, and *Diatomaceæ*, though the limbs seem even worse fitted than before for crawling, since the spines or setæ with which they are fringed are much increased in length, especially on the third pair.

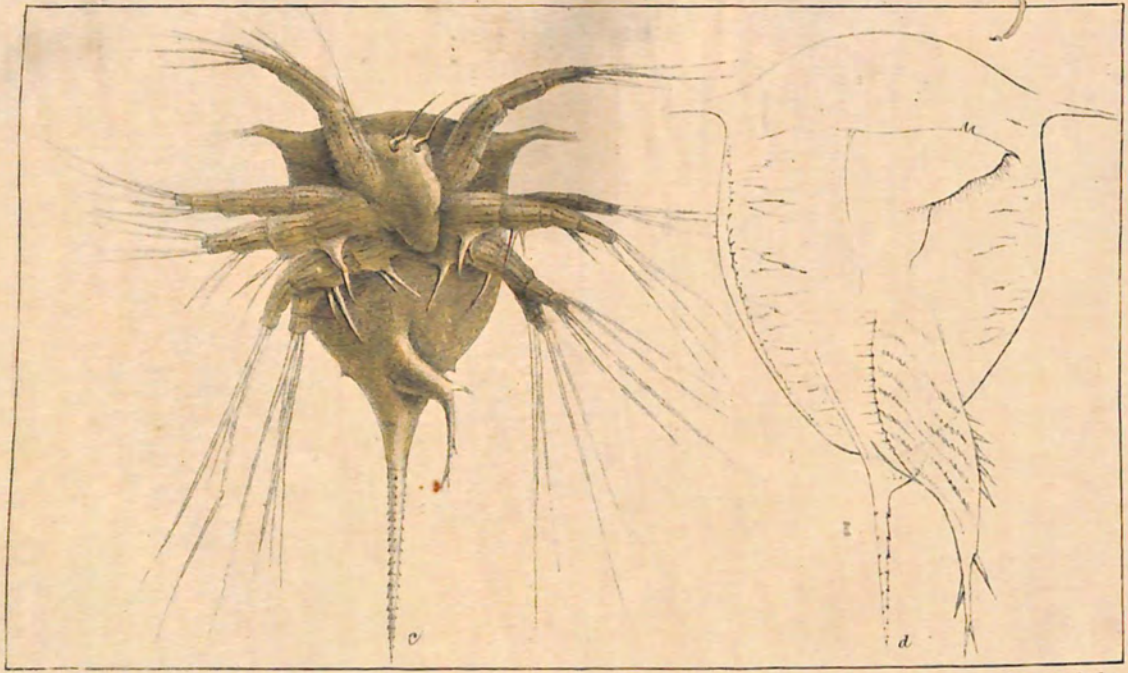
Subsequently, I found another specimen in a more advanced stage. I cannot with absolute certainty say that it was of the same species as the foregoing, as it was taken in water dipped from the open sea. I have, however, reason to believe so. The form and details agree well with those of the preceding, notwithstanding the changes produced by development. (See Plate IV. fig. *d*.)

In the accompanying figure I have neglected the limbs, in which no alteration of importance was noticed, in order that I might give with greater clearness the modifications which have taken place in what, I suppose, I may safely assume to be the second moult. These are chiefly in the proboscis and the anal fork. The proboscis now points directly downwards, is furnished with a pair of minute spines on its anterior side, and with a terminal hook; while its posterior side is set with strong vibrating cilia. The anal fork is greatly increased in dimensions, has its edges armed with spines articulated to its surface, and is marked with longitudinal lines which resemble corrugations. The under-surface of the body is also much corrugated transversely.

In the first moult the spine of the carapace was greatly increased, the size of the body itself remaining stationary: in the second moult the ratio is reversed, the body has largely increased, but the spine is nearly *in statu quo*.

I regret that the loss of the specimen prevented my making my observations more complete. Hence many details are omitted; for I prefer the giving an incomplete figure, to filling in details from indistinct memory, or conjecture. I merely vouch for what I have represented, not for the absence of what is wanting.

The further progress of the infant Cirriped I know only from the observations of others, and mainly from what has been recorded by Mr. Darwin in that monument of research and acumen, the "Monograph of the Cirripedia." No appreciable advance has been made



P.H. Gosse del. et lith.

Vincent Brooks Imp.

Young Barnacles.

by either of these two moultings, from the free, jerking, dancing Water-flea that was first hatched, towards the sessile Barnacle enclosed in its shelly cone of several valves, and firmly fixed to the solid rock; and we are yet at a loss to imagine how such a change can be effected.

Nor is the matter apparently helped by the next moult; for though there now ensues a great change of form, it does not seem to resemble the adult Barnacle much (if at all) more than before. If described without reference to its parentage, it would still be considered an Entomostracous Crustacean or Water-flea, but removed to another Tribe. It represents, in fact, a *Cypris* or *Cythere;* the body with its fringed limbs being now included within two convex valves, like those of a mussel or other bivalve shell, either united by a hinge along the back, or rather soldered together there, so as only to allow a slight opening and closing by the elasticity of their substance. The fore part of the head is now greatly enlarged, as are also the antennæ, which project from the shell. The single eye is separated into two, which are large, and attached to the outer arms of two bent processes which are placed within the body, in the form of the letters **U U**. The legs are increased by the addition of two pairs, and these are doubly bent in a zigzag form, and can be protruded from between the valves.

It is a highly curious fact that the infant animal has thus passed through two distinct types of animal life, the *Cyclops* and the *Cypris*. These are not one type in different stages, as might be reasonably presumed. The young of *Daphnia* and of *Cyclops* are

so much alike, that it would be natural to presume the young of *Cypris* to be of the same form; in which case, we should have in the young Cirriped merely the first and second stages of *Cypris*. But it is not so: *Cypris* does not pass through the *Cyclops* form at all; for, according to Jurine, the young when hatched have the appearance of the perfect animal, though varying a little in the shape of their shells.*

It is in this second form, which may be considered the *pupa* of the Cirriped, that the animal quits its free roving life and becomes a fixture for the remainder of its days. And this is a most wonderful process; so wonderful, that it would be utterly incredible, but that the researches of Mr. Darwin have proved it incontestably to be the means by which the wisdom of God has ordained that the little Water-flea should be transformed into a stony Acorn Barnacle.

Having selected a suitable place for fixing its residence—such as those massive rocks which sustain the impetuous billows at the mouth of St. Catherine's Cavern—the great projecting antennæ manifest a new and unprecedented function. Glands situated at their base secrete a tenacious glue, which, being poured out in great profusion, cement the whole front of the head to the rock, including and concealing the antennæ themselves. The cement rapidly *sets* under water, and the animal is henceforth immoveable.

It now moults its skin once more. Another great change takes place: the bivalve shell is thrown off, as are also the eyes with their bent supports, and it is seen to be a true Barnacle, though as yet of minute

* Baird's British Entomostraca, 150.

dimensions, and with its valves in a very rudimentary condition. It is now the representative of a third type among the Crustacean forms, for it is in effect a Stomapod; such as the Opossum Shrimp (*Mysis*), for example, with the carapace composed of several pieces, stony in texture, on account of the great development of their calcareous element, and so modified in form as to make a low cone, the legs (become the *cirri*) made to perform their movements backwards instead of forwards, and the whole abdomen reduced to an almost invisible point.

These Cirripeds, whose infant biography I have been recording, are tenacious of life. The commoner species, *B. balanoides*, that studs by millions the surface of these limestone rocks between tidemarks, is necessarily exposed to the air for several hours during the recess of every tide. But in this large sort I had a yet more striking example of power to resist ungenial circumstances. A cluster of some three or four that I had been keeping in water for a fortnight, I had at length taken out to preserve for my cabinet, supposing that a brief exposure to the sun's rays would both kill and dry up the animals. They lay in a window for twenty-four hours; at the end of which time, on taking them up, I saw, by the snatched closing of the interior valves, that life was not departed; and on my dropping them again into a vase of sea-water, they immediately commenced making their casts as regularly and orderly as if nothing had happened; though for several hours of their exposure they had lain in the unmitigated beams of a hot July sun.

Plates III. and IV. represent different stages of the larva of *Balanus porcatus*, magnified.

a. The larva just hatched; ventral aspect.

b. The same; lateral aspect.

c. The larva after the first moult; ventral aspect.

d. The larva (presumed to be of the same species) after the second moult; ventral aspect (the limbs and some other details omitted).

XIV.

LIDSTEP.

The Sound—Giltar Cliffs—Bear Cave—Sea-weed Forest—Guillemots — Ribweed — Dangerous Hole — Sewin-fishing — Flat-roofed Caves—Pillars—Rouse Hole—Proud Giltar—Grandeur of the Bluff—Lidstep—Perpendicular Strata—Abbey-like Area—A natural Palace—The Droch—Sea-birds—Shrinkle Head—Insular Rock — Zoophyte-hunting—Fine Anemones—Medusæ—Sea-weeds—Beauty of the Ciliated Ceramium.

July 11th.

We wished to explore the coast beyond Giltar; that fine bluff that shuts in the view as we look from the South Sands westward. Accordingly we all took boat, and ran down through the Sound. Once round Giltar, the coast became very picturesque: the crags were fantastic, the precipices abrupt and sheer, and the shutting in and opening up of the little rocky coves every instant, as we sped along, gave a perpetual interest to the scene, changing it like a moving panorama. Caverns with funnel openings above were numerous, and there were many others deep and highly picturesque. One in particular has received a name from its singular appearance. It is a yawning chasm in the face of the cliff, in the centre of which there is a most excellent image of the face of a colossal Bear, as if crouching in the

cave, with his nose on the water's edge. The pointed ears, the half-closed eyes, the nose and muzzle, are all excellent, almost too good to be true; till, on approaching, you discern that every feature is merely some natural crevice or angle, or rounding of the wet and slimy rock.

The *vraisemblance* was so perfect that I made a hasty sketch of it, and afterwards landed to explore the cave. The mimic head is fifteen feet high, and is the extremity of a great groin which divides the cavern into two passages. Up one of these I groped about two hundred feet, but did not reach the end, though the smooth and lubricous walls were gradually narrowing. On the other side, the fissure slants upward, with ledges projecting from the sides, and rock-pools accessible by climbing. I did not, however, see anything of interest in such as I examined.

Close to the right of Bear Cave,—that is, on your right as you look into it,—stands a jagged peak in the sea which is connected with the main by a natural bridge, like London Bridge Rock at Torquay.

The water here was brilliantly clear, and very black as we looked down perpendicularly; an appearance produced (as we could see by steadily gazing) by a forest of *Laminaria*. While I was exploring, the men dragged up some of the fronds for the rest of the party—huge leathery streamers, eight or ten feet long. On these were feeding, like oxen on a broad savanna, several specimens of the exquisite little Tangle Limpet (*Patella pellucida*), distinguished by having on its apex three lines of most gem-like azure.

Then we come in front of another noble vault, out

of which fly a troop of Guillemots, or, as the boatmen call them, "Mers." Here we pass over fields of another great Alga, the Brown Ribweed (*Alaria esculenta*), looking like the tail-feathers of some fabulous bird, some long-tailed species of Roc, or undescribed *Dinornis*, preserved to grace the mantelpiece of Father Neptune and Mother Thetis.

Now appears a noble head, which many affirm to be Proud Giltar; its seaward side formed like the outline of a haystack, and the strata standing in regular perpendicular parallels, like basalt, as Arthur observes, who has seen the north of Ireland. Just on this side of it is a little cove, with a pretty gravel beach, on which one of our men looked with interest.

"That's what they call Dangerous Hole, Sir. 'Tis a fine place to haul for sewin [salmon]. Jem Brooks and me first tried the place about six year agone, and at the first haul we got three mauns of sewin, only just hauling the net round, without e'er a rope."

Beyond this we see a succession of arches, and caves, and flat-roofed rooms, perforating the foot of the cliff,—a curious phenomenon, dependent on the perpendicular direction of the strata. Somewhat similar appearances occur on the other side of the bluff; a series of low arches divided from each other by massive pillars, with contorted feet of white marble. These arches were as curious as anything I had seen, and recalled, while they greatly excelled, the excavations near the southern extremity of Portland. One of them, particularly fine, named Rouse Hole, resembled a noble doorway, such as might have given entrance to an old Egyptian temple; it was situated

at the summit of a rising bank of sand, and was skirted by a row of three or four smaller doors at one side, which we fancied to represent the cloisters of the ministering priests.

The men had promised us here another great cavern with an open shaft; but, lo! when we came to look, the whole roof had fallen in, leaving only a heap of red earth and gravel, instead of a cave;—an example of the changes in configuration such a coast as this is continually suffering.

But now we are opposite the real Proud Giltar; and certainly there is no mistaking his kingly presence when once you have looked on his superb face. It is a truly magnificent precipice of grey limestone, nearly two hundred feet high, with the strata perpendicular, and transverse to its projection as a bluff. Hence we see on the face immense flat slabs overlying each other, cracked all over. One enormous slab, near the water's edge, looks as if it had sustained a bombardment, being studded with marks, resembling the bruises of cannon-balls, by hundreds.

We pull across Lidstep Bay,—a shingle beach, backed by low green hills and fields, with a few farm-houses. Lofty red cliffs again occur on the further side, quarried out. Sloops are lying under the precipices, as if at a quay, loading limestone for Cardigan and Bideford.

Now we are under Lidstep Head; a promontory in steepness and height rivalling its "proud" opponent. I never before saw cliffs like these. The stratification is absolutely perpendicular, and as straight as a line,

taking the appearance at every turn of enormous towers, castles, and abbeys, in which the fissures bear the closest resemblance to loopholes and doors.

Great areas open, enclosed as if with vast walls. The sea-surface was particularly smooth, and we ventured to pull into one of these, exactly as if into a ruined castle or vast abbey; chamber opening beyond chamber, bounded and divided by what I must call *walls* of rock, enormous in height, and as straight as an architect's plumb could have made them, with the smooth sea for the floor. If the tide had been high, instead of being low-water of a spring-tide, we might have rowed all about this great enclosed court; but as it was, the huge square upright rocks were appearing above water, like massive altars and tables. The sea was perfectly clear, and we could look down to the foundations of the precipices, where the purple-ringed Medusæ were playing. Altogether, it was a place of strange grandeur: we felt as if we were in a palace of the sea-genii; as if we were where we ought not to be; and when a gull shrieked over our heads, and uttered his short, hollow, mocking laugh, we started and looked at one another, as though something "uncanny" had challenged us, though the sun was shining broadly over the tops of those Cyclopean walls. Probably the associations of yesterday's excursion had something to do with all this,—the remembrance of the ruined palace, and the castle: those were grand; but how far grander was this masonry of nature than anything we saw yesterday!

We left this natural palace with regret; but the tide

was near its lowest ebb, and I wished to be on the rocks for whatever might be obtainable in Natural History. The lads, therefore, gave way, and we swiftly shot past this coast of extraordinary sublimity. Presently we come to the Droch, where a more majestic cavern than any we had yet seen appears. Up on a beach of yellow sand its immense span is reared, with a secondary entrance. The arch of uniting stone is thrown across with beautiful lightness, and appears as if hewn with the mason's chisel. Dark domes are seen within, far up in the lofty vaulted roof; and pools of still, clear, glassy water mirror the rude walls. This is certainly a glorious cave.

Bear in mind still that the stratification is perpendicular, as this circumstance imparts so very peculiar an aspect to the whole range of rocks. All the ledges are horizontal, like courses of masonry; all the fissures are vertical.

Hundreds of birds are sitting in rows on the ledges, and at the margins of the clefts, which the boatmen call Eligugs; I think the species is the Razor-bill (*Alca torda*) from its appearance. As they sit bolt upright, with their black backs against the rock, and their snowy breasts facing the sea, all side by side, like soldiers in rank, they present an amusing appearance. At a shout, down swoop the old ones to the water, with a cluttering noise, leaving the young still sitting. As we passed one peak, or rather flat-topped square column, like an obelisk, a brood of young Cormorants, only half-fledged, leaped off; and, though unable to fly, dived with

most effective celerity. It is interesting to mark how early the instinct of a young animal teaches it its true powers for defence or escape, and how cleverly it manages to take care of itself, by bringing those powers into requisition in the most effectual way.

This point formed the limit of our excursion; but just before us we saw the lofty promontory of Shrinkle, with a pleasant sand-beach at its foot. The dark red hue of these lofty cliffs contrasted with the grey of all that we had passed, and showed that here a new geological formation commences, the mountain limestone giving place to the old red sandstone, which has been here upheaved through it. The direction of the strata is still quite perpendicular; three great projections are very prominent,—enormous upright straight-sided buttresses, crowned and draped with verdure, bearing a most deceptive resemblance to the carved work of some Gothic cathedral, ruined and ivy-clad. Perhaps I ought to apologize for repeating similar comparisons; but I know not how otherwise to convey to you an idea of what was so forcibly impressed on our own minds by the continually recurring mimicries of this most remarkable range of cliffs. These comparisons, after all, are derogatory to the rocks,—they are suggested by the forms alone; but the massive grandeur of their dimensions far exceeds the ordinary works of human art.

Just off the great cavern at the Droch is an insular rock of no great area; but which, in its dark hollows and crevices, seemed to promise me a successful search for marine animals. I was accordingly

deposited here with my "traps," while the ladies went on shore to explore the caves and enjoy the sands. The lower parts of the rock presented several pools, some of which were of considerable depth, shaded over and concealed by great fronds of *Alaria* and *Laminaria;* for in ordinary tides the whole surface would be covered by the sea. Lifting the large brown fronds and laying them back on the edge of the pool, I gaze down, and in a moment see that the rough sides are rich with Actiniæ. The Snowy-disk (*Sagartia nivea*) studs the dark margins of the basin with its white stars, like jasmine-blossoms against a wall; and many specimens of that very rare one, the Rosy (*S. rosea*), as lovely as it is scarce, were protruding from the cavities. Unfortunately most of these were so far down, or so protected by projecting angles of rock, that though I could see them plainly enough, and even touch them with my chisel, I could not secure them; for the first attempt to cut the rock caused them to retreat out of sight; after which, working away blindly at the hard limestone was of little use. I managed, however, to obtain about half-a-dozen, which were more than I had ever seen before together. Certainly it is a charming little thing; rarely larger than a small marble, and generally less, it does not expand much; but its whole disk and tentacles are of the most beautiful rose-crimson, occasionally with a tendency to scarlet around the mouth. The tentacles are small, close-set, and fringe-like; and are frequently puckered into frill-like folds, like the margin of *S. bellis.* (See *Frontispiece.*)

In some dark angles of the rock—not pools,

because the water did not stand in them—I had the gratification of discovering a new and very distinct species, the Glaucous Warty Anemone (*Bunodes thallia*). In habit and form it much resembles *crassicornis* and *gemmacea;* but its colour is a glaucous or greyish green, with a variegated disk, and tentacles splashed with opaque white. (See Plate XXIII.) About a dozen specimens were congregated here, all of which I obtained with a readiness and an ease that contrasted with the difficulty of getting at the lovely *rosea*, and other hole-dwellers. *B. crassicornis* was very abundant, five or six crowded into every corner, and easily discoverable by a practised eye, notwithstanding the veil of gravel with which this species aims to conceal itself. Yet this habit is a very curious one, and, to any eye but that of a trained zoophyte-hunter, would be an effectual blind. The surface of the body is studded with protrusile warts, the extremities of which are hollow, and have the power of attaching to themselves, by means of the suctorial action of a vacuum, small fragments of stone, broken shell, and similar substances. In this disguise it often lies exposed to the air for two or three hours, its concealment aided by the profusion of similar fragments in the angles which it usually haunts. *Bellis*, as well as *crassicornis*, has this sagacious trick; but, what is more surprising, it is practised only in circumstances where it is of any use. Both of these are deep-water species; I have frequently dredged them from the bottom of the sea, but have invariably in such cases found the body quite naked; the disguise would be useless

there, and therefore is not practised. Many of the specimens found here were very gorgeously marked; especially those which were under water, and therefore fully expanded. They display great variety, scarcely two being exactly alike; those with almost opaque white tentacles are perhaps the most striking; but those which have the whole disk and tentacles full crimson, and those in which the latter organs are purple with white rings, are also very ornamental.

Having pretty well rifled the pools, I took my muslin-net and began to dip in the clear shining water for Medusæ, or whatever else might be enjoying the warm sunshine at the surface. I took two or three specimens of a little hemispherical *Thaumantias*, which is, I think, *T. Thompsoni* of Forbes's Monograph; and also that little gem of the sea, *Cydippe pomiformis*, that looks like a living and active globule of clear glass. But of this, as well as of one or two other things, I may have to speak again.

After I had sufficiently examined this rock and some others contiguous to it, I removed to the western side of the bay, where I found many pools very rich in Algæ. The fine fern-like *Desmarestia ligulata*, and the olive ribbon-shaped *Alaria*, overshadowed many of the purple and crimson species. Four kinds of *Delesseria*, the much-branched and brilliant *Plocamium coccineum*, not often found in tide-pools; *Dasya*, with its peculiar hairy twiglets; *Nitophyllum laceratum*, a much-cut leaf of transparent pink gelatine; and tiny feathery *Callithamnia*, I found in the darker nooks, besides many of less pretensions to beauty of colour or form, *Rhodomela*, *Laurencia*,

Polysiphonia, *Ceramium*, &c.,—all, however, interesting in their own way. Stay, however! One of the last named genus does deserve a more particular notice; not exactly for its colour, though this is chaste and elegant, but for the exquisite delicacy of its form, and for the curious manner in which it is armed. It is *Ceramium ciliatum*, a thick tuft of which I obtained. It is composed of many slender much-branched threads, each of which at the tip forms two hooks or curls looking towards each other,—a feature which is more or less characteristic of the genus, and which here, where it is strongly marked, imparts a very singular and unmistakeable aspect to the plant. The stems and branches are jointed at regular intervals, and every joint is quite clear and colourless in the central part, and purple at both extremities. Add to this, that at each joint there is a circle of stiff glassy prickles, which stand out in a radiating manner; so that, on the whole, the species is one of the most pleasing objects one can find, especially when subjected to microscopical examination.

XV.

ST. MARGARET'S.

Caldy and St. Margaret's — Exploring Trip — Rugged Rocks — Brussels Hole—Dead-man's Finger—Its Changes—Crested Plumularia—Its Beauty—Its Curious Vesicles—A populous City—Warty Gigartina—Gelidium—Sea-hare—Its Purple Dye—Curious Analogies—Herbivorous Stomachs—Striped Polycera—St. Margaret's Caves—Shoal of Mackerel—Majesty of the Caverns—Medusæ and Beroes—Guillemots—Curious Mistake—Maternal Love—Cormorant taking Prey—Instinct at Fault—Eel and Crab Fishing.

July 12th.

CONSPICUOUS in the seaward view from the south cliffs and sands of Tenby are the two islands of Caldy and St. Margaret, which, acting as a natural breakwater, form a great protection to the town against the force of heavy seas from the south and west. Of the two, Caldy is by far the larger, St. Margaret's the more picturesque. The latter is broken at its two extremities into angular columns and needles of the most odd and fantastic shapes, which look most singular when the rising tide hides their mutual connexion at the base, and insulates them in the foaming sea. At low water there is a long low ridge of rock which unites the two islands; and as I thought, from its appearance, this ridge might be worth exploring, we made a party to visit it, which was rendered the more delightful by the company

of my valued friend and fellow-labourer in marine zoology, Mr. Dyster.

The day was gloomy, the sky leaden, the sea wild and angry-looking, but not rough, and the breeze was fair. We quickly ran down, for the distance is but two miles, and landed on the low isthmus, which on this side is a beach of shingle, with small boulders spread on it.

D. and myself crossed at once to the outer side, presently finding ourselves among the roughest possible rocks, heaped on one another in wild confusion, with keen edges, sharp prominent peaks, and honeycombed surfaces; broad pools, and streams of seawater forming miniature cascades, and deep narrow fiords or inlets from the sea, immensely clogged up with *Laminaria*, and *Fucus*, and *Rhodym. palmata.*

It was spring-tide and low-water; yet our search, though laborious enough, was singularly unproductive. The water's edge was very difficult to approach, so as to work with any comfort or perseverance, chiefly from the abrupt angular character of the rocks.

I roamed on alone towards St. Margaret's, where some peaks of higher elevation encouraged me to hope I might find those overhanging sides which are often so well-stocked with animal life. To reach them I had to traverse half a mile of peaks and boulders, very slippery and dangerous: in fact, I got some rather bad falls, though practice has made me tolerably sure-footed among the rocks. I skirted the edge of a large circular pool, very deep, called Brussels Hole, separated from Tenby Bay by a beach, and communicating with the south side by a rocky

narrow streamlet, winding its way among the peaks, a rapid descending river of salt water.

Here I found no sphere of successful labour; but pushing on, scrambling, climbing, straddling, sliding, leaping, creeping, over, under, and through the wilderness of slimy stone, I came at length where the peaks became bolder, and the sides more overhanging. Here in the shaded nooks were several species of Anemones, and some of them fine, but no novelties. Very fine masses of that curious zoophyte, the Dead-man's finger (*Alcyonium digitatum*), were hanging in variously-lobed and finger-like forms from the arching rock. Uncouth and repulsive they were in these circumstances,—long flaccid lumps of whitish leathery flesh, drawn out so as to hang by a slender skinny neck, with a globular drop of water pendent from the tip; but recovering all their beauty as soon as the returning tide embraces them. We cannot indeed examine them then; but by detaching one, and immersing it in a glass of clear sea-water, we can witness the change. It contracts the skinny flaccid neck, till the form is plump and firm; then it slowly absorbs the surrounding water, replete with the life-giving oxygen, into its system of permeating aqueducts. Under the stimulus, after the long abstinence, the polypidom swells and gradually becomes pellucid, the polypes protrude, and at length the whole mass is bristling with these most elegant translucent and flower-like animals, as I have elsewhere described in full.

Some of the stems of the Sea-weeds that were growing rather deep in a pool were loosely covered with

that exquisite Hydroid, the Crested Plumularia (*P. cristata*). Certainly this is the most beautiful of the genus that I am acquainted with. A horny thread winds over and around the weed, sometimes adherent, and at others coiling irregularly at some distance from it. This is the axis or stem; from which, at intervals, beautiful spreading plumes spring, about a couple of inches long, and a third of an inch wide. Each plume consists of twenty or thirty pairs of pinnæ, diverging with perfect symmetry; and every pinna is a chain of eight or ten joints, each of which carries on its upper side a cell, the shape of which old Ellis compares to that of the blossom of the Lily of the valley, only that each flower-like cell has a sort of handle like that of a saucepan projecting from its inner side.

From many points of the stem or of the plumes issue the reproductive vesicles; and these form the most interesting feature of this zoophyte, and one by which, when they are present, it may immediately be distinguished from all other species. One of these vesicles is a membranous bag or pod of a flattened oval form, with a number of transverse ribs or notched ridges passing across each surface on the outside, and a stiff stem connecting them, running along one edge of the bag. I incline to think that a vesicle is an abortive plume, of which the ridges are the pinnæ; these, arching over, meet at their tips; and the interspaces, being filled with the thin horny clear yellow membrane, make the continuity of surface which constitutes the sac.

Mr. Lister computes 400 to 500 polypes as inhabiting an average plume; and this agrees pretty well

with my own observation. But Dr. Johnston greatly underrates, when, proceeding upon this estimate, he computes "6,000 polypes as the tenantry of a single polypidom." * Instead of specimens containing each twelve plumes, he might have spoken of such as comprise fifty; such samples are common on these shores, as well as in the coves of North Devon; and these would contain something like 24,000 inhabitants. Such is the profusion with which life, and consequently happiness, is scattered by the beneficent Creator, in these vanishing forms.

In one of the little ponds I found growing profusely that singular Sea-weed, *Gigartina mammillosa*. It is branched and tufty, with a considerable resemblance to *Chondrus*, but more rigid; the frond so divided as that the terminations are flattened or hollowed, and broad at the tips; they are of a blackish purple hue, and their surface is studded with little oblong warts that stand up on short stalks.

Another Alga of much higher claims to beauty was also found here growing in little low tufts, scarcely more than an inch and a half in height. This was *Gelidium corneum*, remarkable for its vivid red colour, when the light is transmitted through its substance, and for its prettily cut outline. It is much branched, the branches fringed with subordinate branchlets, and these again beset all along their opposite edges with narrow processes; the whole plant perfectly flat, as if it had been stamped out of a piece of cardboard, or rather out of a sheet of crimson gelatine. It is a plant subject to great variety in the

* Brit. Zooph.; p. 93. (2d Edit.)

form, arrangement, and position of its feathery appendages; the specimens that I obtained here seem to be the variety named *pinnatum*, which is not uncommon on the opposite shores of the Bristol Channel.

When I returned to my friend, I found him in possession of several great uncouth creatures which he had obtained by turning over the loose stones. They looked at first like shapeless masses of dark purple flesh, some three inches in length; but soon they began to crawl, when thrown into one of the clear rock-pools, and then they displayed their proper form. They were now seen to be Mollusca allied to the Nudibranchs (the *Dorides*, the *Eolides*, &c.), but separated from that group by certain technical peculiarities of their breathing organs. Like those, however, these crawled, or rather glided, along over the stones upon a flat fleshy disk or foot, and up the slender stems of Sea-weeds by bringing the edges of the same muscular foot to meet around the stem, grasping it thus, as if enclosed in a tube. The fore part, as the animal progressed, was poked forward as a narrow neck, furnished with two pairs of tentacles; one pair of which, standing erect, and being formed of thin laminæ, bent round so as to bring the edges nearly into contact, looked like the long ears of a beast; whence this creature is called by the vulgar the Sea-hare (by naturalists, *Aplysia punctata*). On each side of the body, which is large and semi-oval, rises up a great fold of flesh (the mantle), which, arching over the back, is itself overlapped by its fellow on the opposite side. These wings are some-

times carried apart, exposing the back, and are said to be used as swimming fins; but this I cannot affirm from my own observation. The colour, as I have said above, was purple, a dark brownish purple, studded with rings and spots of white, giving it rather a striking appearance.

The whole genus is well known to naturalists, as giving forth a colouring fluid, which, however, from its volatility, is of no value or applicability in the arts. These specimens readily gave us ocular proof of their endowments. Sometimes on being disturbed, and sometimes quite spontaneously, or at least without any visible cause, they would pour out from beneath the mantle-lobes a copious fluid of the richest purple hue, which stained the stones, the sands, and the water, of the same gorgeous tinge. When one was transferred to a large glass collecting-jar of sea-water, the contents presently became of the fine colour of port wine; and when this was replaced by clean water, it was very soon empurpled again. We could not help observing, "What a pity that so noble a stain could not be rendered permanent!" As it was, however, a few hours sufficed to remove all trace of it.

Some naturalists have affected to marvel at the comparison implied in the term "Sea-*hare*," as if it were altogether imaginary. For my part, I think that the resemblance of the animal, when partly extended, to a hare squatted in form, is a very obvious one. Indeed, I suspect that such *vraisemblances* as are perpetuated in common names, are rarely despicable or visionary. In Dorsetshire, the animal is

known as the Sea-cow; this appellation, which turns the dorsal tentacles into horns, is scarcely so felicitous as the other.

All the animals of the genus are vegetable feeders; and by a curious analogy with the herbivorous Mammalia, whose proper names they borrow, their digestive apparatus is highly complicated. According to Cuvier, there are three stomachs; a short narrow gullet dilates into a large membranous crop—a curved bag, which is generally found filled with pieces of coarse Sea-weed. This large crop or paunch occupies the right side of the body, and opens laterally into the middle stomach, which is the smallest of all, and performs the part of a gizzard. Its coats are thickened; and the interior callous lining is beset with firm horny processes, in the form of rhomboidal plates or molar teeth, which serve to compress the softened vegetable matter transmitted in small portions from the first stomach. The third cavity of this complex apparatus is placed on the left side of the body; its interior surface is studded with sharp horny spines, resembling canine teeth, to pierce and subdivide the coarse food, and thus prepare it for the action of the gastric juice, and other fluids accessory to digestion, which enter the stomach from adjacent organs.

The complexity of this structure has reference to the coarseness of the materials on which the animal subsists,—the leathery fronds of the olive Sea-weeds, which slowly and with difficulty yield their nutritive elements to the digestive functions. And the whole organization affords us an instructive example of the Divine resources, and of the adaptation of organs to

their requirements which an enlightened research is continually finding in Creation. We might scarcely have been prepared to expect the complex repetition of stomachal cavities proper to the ruminant Mammalia in one of the MOLLUSCA, nor a formidable array of canine and molar teeth hidden far down in the interior of these organs.

Besides these fine Tectibranchs, a beautiful little member of the Nudibranch Order had rewarded the researches of my friend,—*Polycera quadrilineata*. It was a slug nearly an inch in length, white, with four lines of rich yellow spots, a tuft of gill-plumes on the back, a pair of clubbed tentacles in front, and a pair similar in appearance (but not in function) behind.

When we had all scrambled into the boat again, and the brawny fellows had shoved her down over the grating pebbles, so that she was well afloat, the question was, Whither? "Home," said some. "Nay," said another, "since we are out here, let us take a peep at the Caverns they brag so much about. The tide has scarcely turned."

"Agreed!" cried all; and a quarter of an hour's hearty pulling brought us through the Sound to the west end of the Island.

No phenomenon in Natural History excites a sailor so much as a shoal of fish. Our fellows were all agog at the sight of a shoal of Mackerel ruffling the surface of the sea as we were passing through the Sound. You should have heard their uncouth exclamations, and seen their eager glances and gestures, as the black fins and tails appeared cleaving the silvery wave; or as the playful fishes leaped, a dozen or more

at once, out of the sea, with a gleam and a splash, like the Flying-fishes that I have watched with so much delight in the tropical Atlantic.

We rounded the point of St. Margaret's, and found ourselves in a little indentation or cove, with lofty perpendicular walls. There were wide fissures, and intervening columns of solid rock, as straight and clear-edged as if hewn by a statuary, running up to the very summit, which could not be less than a hundred feet high. On the left was a noble perpendicular-sided cavern; the light appears at the farther end; and the men inform us that a boat can pass right through at high water, emerging at the other side. We pull in a little way, and, looking up, see a great square sky-light or chimney, open to the heavens. The squareness of every feature is as remarkable here as in the Lidstep cliffs, of which this island indeed is evidently the continuation. We are so accustomed to see ruggedness and irregularity of angles in rocks, that these perpendicular and horizontal lines have a strange effect. They convey, in spite of reflection, an involuntary association of mind with human art; art in its grandest efforts; and, say what you will about right angles not being picturesque, if you were in these great square caverns, you would confess that there is a majesty about them which ruder forms would not possess. At least, it was so to our minds.

I jumped out upon one of the flat tables of smooth limestone, and peeped into another cave at the back, a fine square hollow, cut far down into the deep sea, and leading under a low rugged archway, which opens

out at the right side, admitting the light, but indirectly. Holes and fissures and crannies were here, purple with the incrusting Coralline, and the rich fronds of *Rhodymenia*. It was beautiful to gaze down into these spacious halls and alleys, and narrow galleries, all under water, which yet was no impediment to the full sight, being as clear as crystal, and as smooth as a mill-pond; while the reflection of the dark roof above precluded that impediment to clear vision under water which arises from the light of the sky reflected from its dazzling surface. It was, I say, very beautiful to look down into the transparent depths, and see the broad fronds of Algæ, crimson, purple, and olive, slowly waving to and fro with the gentle ground-swell; to gaze on the many-coloured Actiniæ, expanded like the flowers of a parterre; and to watch the *Medusæ* and the *Beroes*, scarcely less transparent than the water in which they sported, the one gliding along with laborious energy of pumping, the other shooting and wheeling about, as if by a mere volition, but really by the incessant action of their prismatic paddle-wheels.

As we came out, we saw on the outside of the island—that is to say, the seaward side—numbers of the Guillemots and Auks, young birds of the season, swimming on the smooth sea. These birds certainly do look, when swimming, exceedingly like ducks, and justify the mistake of the poor Welsh woman the boatmen were quizzing about. She had lived all her life without ever seeing the sea; but, coming to Llanelly in her old age, saw the young Mers swimming in the Bay. "Oh, what a pity!" says the bene-

volent old woman; "some poor body has lost their ducks, and here they are swimming in this great pond!"

Our old Palinurus was garrulous on the habits of birds. One or two things which he told me seemed worth recording, as I knew him to be a man of veracity. The Guillemot, or Mer, as he calls it, will never forsake her young while the latter are helpless; and if they be pursued and taken into a boat, the mother bird will follow, and shouts and even stones will not avail to drive her away. If true, this is a pretty trait of maternal affection.

A Cormorant was watching from the topmost edge of one of the slender columnar peaks. Suddenly he swooped down upon the sea, and disappeared beneath the surface, but presently emerged, bearing in his beak a silvery fish, which he carried back to his watch-tower. Then he gave a toss of his head upward, and without seeming to lose his grasp of the prey, so turned it, that it was swallowed head foremost. This is the universal custom with piscivorous birds, to swallow their finny victim head foremost; and the necessity of it will appear, when we consider the mode in which the fins and spines frequently project. But even instinct is sometimes at fault; and the incident we had just seen gave occasion to old Tommy to draw again on his stores of zoological memory.

"Once upon a time I was in Milford Haven: I see a *Comoral* [Cormorant] catch a gurnard. He had got 'un hold by the tail; and whether he forgot to throw 'un up, I don' know, but he tried to swallow

'un so. The prickles took him in the throat, and—bless ye, Sir! he turned over in a minute!"

Two men were thridding the rocky inlets and passages in a boat, pursuing the same occupation as the "Comoral." One sculled the boat, while the other, standing in the bow, probed the fissures. He had a barbed spear; and when he came to a likely hole, he thrust in his weapon, and brought out a writhing Conger Eel. Sometimes he would insert a bent iron rod into a hole, and drag out a great Crab. Either sort of game was acceptable.

XVI.

CAREW CASTLE.

Scotsborough and Gumfreston—St. Florence—Fine View—Carew Cross—Castle—Confessional and its Pit—Cruelty of Popery—Festive Character of Carew—State Rooms—Historic Associations—Ramparts—A hard-pressed Fox—Viper's Bugloss—Tournament of Sir Rhys.

July 13th.

ARTHUR had a great wish to see Carew Castle: and as this was the last day he could spend with us, we determined to make a trip thither, whence he might strike off to Narberth to continue his pedestrian tour.

We passed by Scotsborough, and through Gumfreston; of which I will not say anything more at present, than that they are both as picturesque little places as well can be, because I mean to have a longer look at them one of these days. We got another and a nearer glance at St. Florence than that which we had taken from the Ridgeway, when going to Pembroke the other day; and certainly it improves upon acquaintance. It lies in a most beautiful wide valley, all full of hedges and rows of trees, and clumps of wood;—that variegated sort of scenery, which, though it does not tell in a picture, is so very charming to look upon in nature. The amphitheatre of hills sloping away on all sides, chequered all over with many-tinted fields, from the fresh green of the after-grass,

to the full yellow-brown of the ripe wheat; the tall square tower of the village church, so characteristic of the Flemish settlement of the county, with the little grey village clustering round it, like a group of children round their mother ("Mother Church," Arthur said), all buried in dark trees, with peeps of meadows between, so vividly verdant;—altogether made a most inviting scene.

Then a fine peep at Procella Peak far away to the right, intensely blue; and, from the same spot, looking behind us, Caldy Island, and the shining sea, and Tenby crowning the promontory which juts out into it, and the purple peninsula of Gowerland sleeping on the horizon beyond all.

And now Carew Castle suddenly starts into view immediately in front of us, as if the high road would lead us right through the old gateway. This unexpected apparition of the magnificent pile is particularly striking; and though it has not the advantage of standing on an elevation, yet its own inherent grandeur is sufficient to command admiration.

Before we entered the Castle, however, we turned aside at a bend of the road, to look at an ancient Cross of stone, which stands on a bank by the wayside. It is a thin slab, carved with interlaced work in sections, of very elaborate workmanship, though, by the storms and frosts of ages, now much defaced. Behind there is an inscription, which baffled our accumulated learning to decipher; the characters seemed to my unantiquarian eye to resemble the Irish, but they too are much worn. This Cross is in all probability much more ancient than the Castle.

A respectable looking, and, for his condition, intelligent, man, the model of an English hind, comes out of a cottage with a key, and opens the modern gate of iron bars, which guards the precincts of the ruin. We pass under the gateway with its portcullis, its holes for the effusion of molten lead, and the warder's tower above. The Chapel on the right of the great quadrangle has a crypt beneath it, and each has a confessional; behind the penitent's cell in the Chapel is the dungeon hole again, passing down below the crypt; the guide said that the hole had been explored, and "many bones" had been found in it.

It is good to see such places with one's own eyes; they form a solemn speaking testimony to those grim realities which it is too much the fashion to think lightly of, or boldly to deny, in this age,—the merciless cruelty and bloodthirstiness of Popery, wherever and whenever dominant. The sight of this dark dungeon, as of that in Pembroke Castle before, caused me to breathe more heartily the prayer, that this nation may never again be taken captive in the Papal toils.

I need not go in detail over the splendid edifice. The character of its architecture suggested the lordly mansion, rather than the baronial fortress. Pembroke breathes of grim war; Carew of gay festivity; not but that the towers and battlements and loopholes, even here, spoke of those who watched, spear and shield in hand, while others feasted.

The great state rooms, including the banqueting-hall, the ball-room and the drawing-room, 190 feet in length (as we were told), are comparatively modern, with magnificent windows of carved freestone, some

of them projecting semicircularly; fragments of glass still remain in the stone sashes. The old peasant affirmed that this portion of the Castle was added by "Lord" Carew, when expecting Queen Elizabeth to be his guest. If so, the invitation must have been somewhat long pending; but Leland, with more probability, attributes the suite to the renowned Sir Rhys ap Thomas in the time of Elizabeth's grandfather. In one chamber, containing a beautiful fire-place, the Tudor arms are finely carved in an escutcheon; and tradition assigns this as the room in which Henry VII. was entertained, on his way from Milford Haven to Bosworth.

The walls, as in so many ancient mansions, are perforated with narrow passages, the existence of which was doubtless kept secret from all but the heads of the inhabiting family, to facilitate escape in utmost need. Some of these we saw, though much dilapidated.

Access is easy to the ramparts and towers; and from one of the corner bastions we had a noble view down into the great banquet-hall. An amusing *contretemps* occurred here. I happened to quote the words of Ossian,—"The fox looked out at the window; the rank grass waved round his head. Desolate is the dwelling of Moina; silence is in the house of her fathers;"—when the peasant, who only indistinctly heard what I had said, replied, "Yes, Sir! that is the very window, where you be, that the fox jumped out of. I was in here below, rummaging about, and I smelt a fox; I told the gamekeeper, and he turned in a terrier that soon roused 'un up. The varmint act'ally

run up the staircase, and jumped right out at this window."

"What became of him?"

"Became of him! Killed as dead as a stone."

Walking around the summit of the walls of another tower, I saw a flowering plant of brilliant blue, springing from the edge, and arching over the interior. I reached it: it was the Viper's Bugloss, a curious plant as well as beautiful, every part studded with black glossy tubercles, and with silver hairs, like those of a hoary head. It seemed to me a touching symbol of the Castle, beauty and age combined. Or, to quote a more charming simile,—

"——— beautiful it blooms,
Gleaming above the ruin'd tower
Like sunlight over tombs."

As we looked down from the lofty battlements of these now dismantled towers, our thoughts could not help recurring to that scene of courtly splendour which forms the most prominent point in the long history of Carew, the Tournament of Sir Rhys ap Thomas. These fields, now so bare and desolate, were covered with a glittering pageant; the gay scarves and painted shields, and nodding crests of the knights, their glittering armour, their prancing steeds, the standards and pennons that floated in the breeze, the gorgeous coats of the heralds, the many-coloured devices of the squires and retainers, the gay dresses of the ladies,—must have formed a strong contrast to these silent and mouldering grey walls.

But perhaps you do not remember the incident to which I refer. Then I will describe it, as I learn

the particulars out of the old chroniclers; for a pageant such as this was a thing that they delighted to dwell upon.

THE TOURNAMENT OF CAREW CASTLE.

Sir Rhys ap Thomas determined to hold a grand Tournament at his Castle of Carew, in honour of St. George's day. By public invitation knights and gentlemen, with their retainers, assembled from all parts of Wales, not omitting the ladies, of course. Five hundred military guests responded to the call, and as many more were gathered as spectators.

The festival lasted five days. Two of these were occupied in preliminary ceremonies, the third was St. George's day. Sir Rhys and the chief of his guests paid a visit to the Bishop at Lamphey in great state, and the Bishop with his clergy returned to the Castle to dinner.

The banquet was spread in the great Hall; this magnificent room, doubtless, where the grand windows look out towards the north. Here two tables ran through the whole length, and there was a cross table at the head for the presence (only imaginary, however,) of the King.

"And now the Bishop said grace, the King's chair was turned in token of his absence; the guests *put on their hats,* and dined; the bards attended in their places, and the intervals of conversation were filled by music."

On the next day was the grand Tournament; the challenge was given by Sir Gryffudd ap Rhys, the son of Sir Rhys, and was accepted by Sir William

Herbert, each supported by a number of other noble knights. It was a well-contested field; many a lance was shivered, many a helmet deplumed, and not a few of the knights on both sides unhorsed. So equally, in fact, were the successes and the failures distributed, that the presiding judge, who was none other than the great Sir Rhys himself, found the scales of victory evenly balanced, and declared himself unable to award the palm, without injustice, to either party. And so they retired; the noble host facetiously exhorting his guests "to look well after those ladies at home, whose cause they had so valiantly maintained in the field."

On the fifth day the same opponents contended in all kinds of gymnastic exercises; and here again the line was evenly drawn; nevertheless, in the chivalrous politeness of the time, the award was given (by previous agreement between Sir Rhys and his son) in favour of Sir William Herbert. After this, the whole assemblage rode to Caermarthen, where Sir Rhys once more entertained his guests at dinner, and bade them farewell.

And thus ended this grand spectacle; of which the chronicler has recorded to its honour, that the five days that these thousand people were feasting and vying with each other for superiority, passed "without one quarrell, crosse worde, or unkynde looke happenyng betwene them."

XVII.

SOUTH COVE.

Projecting Ridge—Bay of Sand—Dark Pool—Fine Anemone—Rhodymenia—Large Eolis—An Enemy to Zoophytes—Its Spawn—Scale-worm—Soft Crab—Violet Fiddler—Aquatic Harlequin—Its Leaping-poles—Scale-armour—Microscopic Appearance of the Scales—Their Ribs—Undulations—Stalk.

July 14th.

As you stand at the mouth of the Third Cavern of St. Catherine's,—I mean on the south side, which I have all along considered as the entrance side,—your progress outward is stopped by a great ridge of rock, which runs out across the sands into the sea. It is true that, by wading out into the shallows, you may round this promontory, which otherwise seems to present, like the terrible Bojador to the early Portuguese navigators, an insurmountable barrier to your maritime discoveries in this direction.

However, not choosing the direful alternative of wetting my feet, I boldly determined to attempt the precipice itself. Now possibly you are thinking of some perpendicular cliff a hundred feet in height;—no, this was not so high, nor nearly. In short, I will say nothing about the height. But it was very rough, full of very sharp points, and honeycombed edges, with narrow shelves, just wide enough to shuffle along

upon, holding on to the rock, like a woodpecker on the trunk of a tree.

And thus I got round, till I opened a pretty little bay of smooth sand, the inviting look of which induced me to persevere. This latter part was the worst of all, for it was difficult work to get down without a fall; but the margins of the hollows, though sharp to the feet, gave good hold to the hands; and the barnacles that crowded the lower portions made it anything but slippery. I did not care about returning; for you may set it down as an axiom in cliff-climbing, that wherever you can descend without sliding or leaping, you can certainly ascend.

The rocks have an imposing appearance, when you are on the sands in front of them. The limestone strata slope up from the south at an inclination of about 45° to the horizon, and are broken short, like the courses of massive masonry. There are large caves, but they are not perforate, except, indeed, that one of them has a lateral opening by the side of the principal entrance. All of these were too far up on the beach to afford anything in the way of natural history, and on climbing up the rocks on the south-east side, where there are several pools that seemed promising, they all were barren, till I poked my head into a dark hole, where, in a little basin, there basked the finest *Bunodes crassicornis* that I had ever seen. He was indeed a magnificent fellow, and fully-blown, with his thick tentacles distended to their utmost, and their beautiful tints softened and blended with the pellucid parts in the most charming manner.

The bottom of this dark pool was studded with

fan-like fronds of the *Rhodymenia laciniata*, very rich in hue. Unfortunately I am not able to preserve this lovely Alga alive; I suppose darkness is not only congenial, but necessary to it; for in a glass vase it very speedily loses all its crimson colour, and becomes a mere white membrane. *Delesseria sanguinea*, which is the companion of *Rhodymenia* in these obscure retreats, is also precarious, but perhaps not quite so sensitive. It generally decays at the base of the midrib, which sloughs off, and becomes white, though this may continue for weeks, and even months, before the frond loses its beauty, or seems much the worse. So little dependent for life are the Algæ on their roots, which are rather adhering than nourishing organs.

At the foot of the rocks I found a fine *Eolis papillosa*, one of the largest of our Nudibranch Mollusca, (except that giant *Tritonia Hombergii*, which is nearly thrice the size,) being two inches and a half long, and an inch wide. It is grey, with the papillæ very numerous and uniformly crowded, and is always conspicuously marked by a triangular spot of white on the forehead. It is a fine inhabitant of an Aquarium; but if you put it in, beware of it, for your Actiniæ will be pretty sure to suffer. I have had large Anemones torn up and eaten bit by bit by this great grey Nudibranch, more than once or twice. In the vicinity of this specimen there were several coils of its spawn, attached to the under sides of loose stones. This is a curious object, resembling a thick cord of white jelly, wound round and round in a spiral of several turns; the line not following the simple curve, but undu-

lating to and fro as it goes. The spawn of all this order of Mollusca is interesting and often beautiful.

Under a stone there was one of those flat worms whose back is covered with two rows of circular overlapping scales, a rather large species of *Polynoe*. A barefooted urchin afforded me another opportunity of testing the value of "popular zoology." "That there's a pig. He gets into fish; he crawls through the fish's mouth, and eats all his belly up." The child had evidently confounded the habits of the creature with those of the parasitic Crustacea, (as the *Cymothoadæ* and the *Caligidæ*,) which are found attached to the interior of the mouth of fishes; but the consumption of the "belly" was probably his own deduction from the premises. It is, however, a curious worm, and interesting, from its structure at least; of its habits we know little, except that it crawls about under stones at low-water mark, holding fast to their under surfaces.

One of the dark cavities contained a young individual of the Eatable Crab (*Cancer pagurus*) in soft condition, having recently undergone that wonderful operation, the spontaneous rejection of its entire crust, as a man would throw off a suit of clothes which were becoming too strait for his increasing portliness. And in another cavity close by I caught a glance of a full-grown male of the Violet Fiddler (*Portunus puber*), in high colour, and in prompt readiness for war. This is the most brilliantly ornamented of all our Crabs, being painted with violet or azure and rich scarlet, on a greyish ground. It holds a prominent rank also for size in its class, specimens frequently attaining

a diameter of three inches across the carapace, or "shell," as it is popularly called. It is also one of the most fierce and fearless, presenting its large and sharp-pointed claws gaping widely to seize its foe on any intrusion.

In many of the tiny rock-pools, not only just here, but also on the other side of the island, particularly those that occur in the irregularities of the perpendicular cliffs, there is a curious phenomenon, which puzzles a tyro not a little. The surface of the water is studded with very minute granules of a blackish or rather very dark blue-grey hue, either scattered or gathered into groups; and these atoms, when approached, are seen to leap nimbly about on the water. It is difficult to catch one for examination; but by watching one as it alights on the solid rock, you may, by bringing down the wetted tip of your finger upon it, secure one. It must be done very adroitly, or the nimble harlequin will be sure to evade the touch; yet lightly withal, or you will crush the delicate organization.

For these atoms are soft-bodied Insects, belonging to the genus *Podura*, which is literally (as I need not tell you) Foot-tail. And it derives this name from the curious structure by which these leaps are performed.

The *Podura* is a little grey insect with six feeble legs, which are incapable of raising its body from the surface on which it crawls; but its hinder extremity is furnished with a fork of two long stiff bristles, which are carried, when the animal is at rest, close up under the belly. When it would leap, however, this fork is suddenly and forcibly thrown out into a

straight line with the body, projecting behind; and by the impact of this implement on the ground, or even upon the surface of the water, the whole animal is jerked bodily into the air, to alight as it may happen; for there does not seem to be any definite direction in these jumps. They often leap three inches or more; and as many of them are less than one sixteenth of an inch in length, their vaulting powers may be illustrated by supposing a horse to jump to the top of St. Paul's, or across one of our London squares.

But there is another point of interest about these tiny tumblers. Their colour is derived from a clothing of scales, densely crowded, and so put on as to overlap each other like the tiles of a roof. They very closely resemble, in form, structure and arrangement, those which are well known as giving the brilliant array of hues to a Butterfly's wing. As in this latter case, so in the *Podura*, the scales are removable by the slightest force: the gentlest touch of a lady's finger would displace them, and a number would be immediately seen adhering to the finger's end.

The markings on the scales of this genus used to form one of the highest tests of microscopic excellence; and still those of some species are used for that purpose, though characters still more delicate of resolution are now found in the sculpture of some of the *Naviculæ*. Let us examine some of the scales of the Spring-tail.

If we take a plate of thin glass (I am supposing you have a good microscope and its accessories) and lay it as lightly as possible on one of the insects,

slightly pushing it a little, and then remove it, a large number of the scales will be found adhering to the glass. This may be laid on a slip of common glass, so that the scales may be between the two surfaces; and if the edges of the thin plate be now touched with thick gum-water, the preparation will be preserved free from dust and other injury for an indefinite period. Now bring it under your microscope, with a power of 200 diameters, and you will see a vast number of disks, for the most part oval in form, or nearly so, but yet with considerable diversity. For some are nearly circular, others semi-elliptical, the ellipse of greater or less length, and others again nearly rhomboidal. They vary, too, exceedingly in size, from $\frac{1}{500}$th to $\frac{1}{3500}$th of an inch in diameter, and also in clearness. But in order to judge of this it will be desirable to increase the magnifying power, with a corresponding increase of illumination.

Suppose we have now put on a power of 600 diameters. The disks, *i.e.* the scales, are proportionally augmented in dimensions, and we can see their markings. They consist of a great number (from twenty to seventy, according to the size of the scale) of slender, straight, nearly parallel ribs, which run lengthwise, and of a delicate membrane stretched across them. The ribs project considerably beyond the connecting membrane, at the extremity of the scale, and there are sometimes visible delicate cross-lines between them. It is evident, from careful examination of many specimens, that the scale is composed of two laminæ, each having its series of ribs and its connecting membrane, for one lamina is

often split off in part, when the difference between the two is readily seen, both by the distinct outline of the broken part, and by the superior transparency of the single lamina. In this the ribs are to be seen only by altering the focus.

Besides the longitudinal ribs, which scarcely deviate from true parallelism, whatever may be the form of the scale, and the evanescent cross-lines between these, there is another set of lines, which radiate in a diverging manner, like an open fan, from the stem to the margin. These appear to me to be produced by very delicate undulations of the plane surface.

I have not yet spoken of the attachment of these scales. In the centre of the basal edge there is a little cylindrical stem, very much like the quill of a feather; it is set on not in the same plane as the scale itself, but pointing obliquely downwards, as is seen by focussing; so that when the point of this quill is inserted in the skin, the scale does not slant upwards, but lies quite flat. This is an exquisite provision, which we do not see even in the feathers of a bird. In some of the scales the outline is not interrupted at the junction of the stem, and in some it actually projects in an obtuse point; but in general there is a deep indenture, and the outline is rounded on each side, heart-like. These variations are the exact counterparts of what we are familiar with in the leaves of various trees and plants.

XVIII.

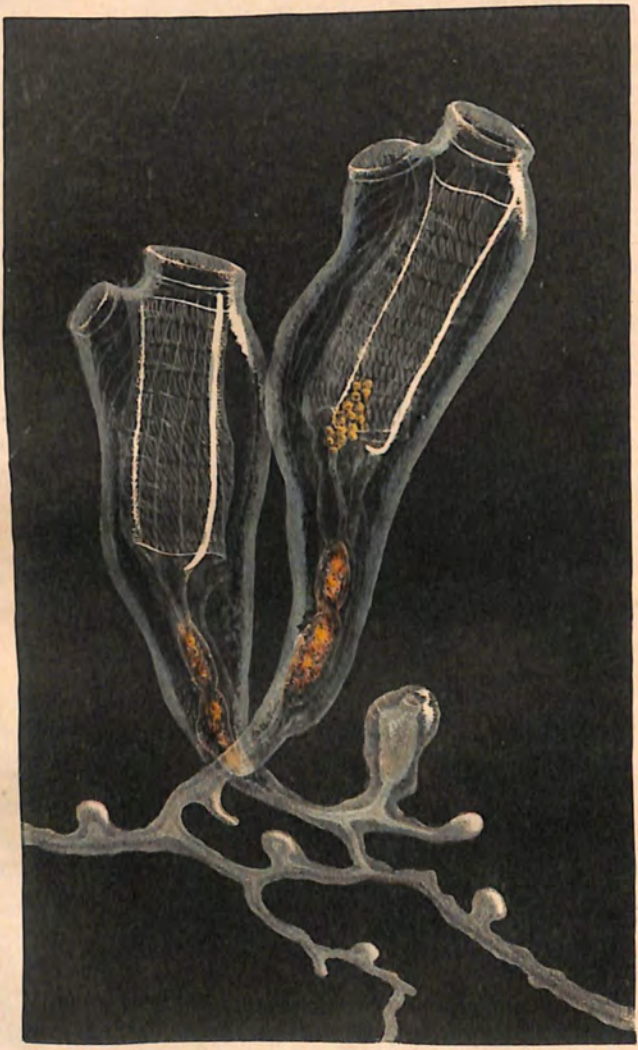
THE CLAVELINA.

Form and Appearance of Clavelina—Its creeping Root—Breathing Sac—Array of ciliated Cells—Beautiful Phenomenon—Ova—Birth of the Young—Description of it—Its Development.

July 15th.

I PROCEED to record some particulars of the economy of that pretty crystalline creature that I found in the North Cove of St. Catherine's, *Clavelina lepadiformis.*

These social Mollusks are animals of very elegant appearance. Each individual resembles in shape one of those ancient amphoræ, or wine-vessels, which were without feet, being set in tripod rings, tall, slender, with a short neck and narrow mouth, and a little handle or ear on one side of the neck. Just suppose the jar to be made of pure crystal, and the ear to be exchanged for a subordinate orifice, like the mouth, but rather smaller, and the whole to be viewed through a diminishing glass,—and the likeness is almost perfect. We will presently reverse the dioptric process, and endeavour, by means of the microscope, to bring our little Mollusk as near as we can to the dimensions of an amphora. For the present, however, let us try what we can make out with our unassisted eyes. (See Plate V.)



P.H.Gosse del.et lith. Vincent Brooks Imp

A Group of Clavellinæ

Half-a-dozen or more of these little crystal pitchers, which are usually about an inch in height, are found crowded together,—the ancients, remember, used to pack their amphoræ in crowded rows,—on the face of the rock. By searching down to their bases, we find that each tapers to a very narrow bottom, where it is attached to (or rather, in natural order, springs from) a slender thread. This is the common base, the root-thread from which shoots up each individual in succession, like young plants from a creeping root.

My friend Mr. Dyster, of this town, who has studied the animals of St. Catherine's Caverns for years, tells me that the animals in their vase-like forms are annual, and that he thinks this creeping root is the only portion that is perennial. The animals appear first rather suddenly at the spring-tides of June; for, as their habitat is below the ordinary tide-level, they can be searched for only at springs. In the autumn they die away, and are sought in vain during the winter and spring. Their re-appearance, however, in the very spots where they were found in previous years, indicates that some principle of life has been permanent, and that the new comers are not the young of the season, produced from ova cast adrift to find a place of abode where they may.

A little way within the mouth of this hyaline vase, where the neck dilates into the shoulder, there is seen a white ring,—the hem or edge of what looks a sac of the finest muslin, hanging down the interior for about half the whole length, and terminating with

a white hem as at the top; both extremities are thus widely open. This is the respiratory organ —the lung of the creature; and the surrounding water constantly pouring in at the gaping mouth, passes freely through this open sac, bathing all its interior, and giving off its oxygen to the vessels that ramify upon it.

On bringing the creature under the microscope we discern the beautiful structure by which this operation, so essential to life, is performed. The internal surface of the sac is divided into transverse bands, about fourteen in number; each band being a row of about a hundred long oval cells, arranged perpendicularly and parallel to each other. The cells are lengthened rings of cilia, which, waving regularly and in unison, force on the currents of water, and probably absorb the vivifying oxygen. The action of these ever-working cilia, the waves of which appear like rapidly revolving wheels, is very beautiful; pleasing the eye by their constancy and regularity, no less than the mind by the perception of their perfect fitness for their prescribed function.

There is a curious apparatus in the interior of this sac, the object of which seems unknown. It is not cylindrical, but indented on the dorsal side, and ridged on the ventral, so that a transverse section would be heart-shaped. The indenture, as well as the ridge, is marked by an opaque white granular band, and the former runs through the centre of a series of triangular flaps, that project horizontally, like brackets, into the cavity of the sac. These flaps are membranous; they have acute points,

and are capable of some alteration of form and direction.

In the narrower part of the body is placed the stomach, and below this the ovary, from which a tube ascends towards the secondary orifice—the common outlet. But in several of my specimens there is a cluster of comparatively large, pale yellow, globular eggs, situated near the termination of the oviduct, in the dorsal indenture of the branchial sac. One of these ova must have become matured, and hatched; for I have just found a little new-born infant *Clavelina*, dancing in the water immediately above the parent. I at once secured it with a capillary tube of glass, for microscopical examination.

The young in this genus, as in all of the Ascidians, whose development is known, is quite unlike the parent, undergoing a metamorphosis before the ultimate form is attained. It bears a considerable resemblance to the tadpole of a frog (see Plate VI. fig. *a*); consisting of a large ovate body, with a thin and long tail; and the resemblance is enhanced by the fact that the whole of this organ is absorbed in the process of growth, and every trace of it disappears.

The body in my young Clavelina was $\frac{1}{70}$th of an inch long, and $\frac{1}{110}$th wide; the tail was $\frac{1}{28}$th of an inch long. The body consisted of an ovate envelope of perfect transparency, in which a multitude of minute clear granules were irregularly imbedded. Within this envelope was an opaque sub-quadrangular mass, in which an oblique incision, curving downward, nearly separated the frontal portion from the

rest. The frontal part bore on its summit two prominences, which were somewhat erectile and contractile.

The tail consisted of a solid axis, enclosed in an ample gelatinous envelope, the edge of which was so subtile as to be detected only with the most delicate focussing, and the substance of which was full of granules like the integument of the body. The central portion of the axis was divided by transverse planes into an immense number of joints, and looked like the vertebræ of a fish.

This specimen died from the confinement and manipulation needful for its microscopical examination. But I marked a tiny white speck adhering to the side of the glass jar in which the group of *Clavelinæ* were living; and this latter I suspected to be a young one, passing from the tadpole condition: a suspicion which was afterwards confirmed. Fig. *b* represents it as it appeared under a lens, July 4th, at 9 A.M.; an oval ball of clear jelly, with a well-defined oval nucleus, much more opaque, and of a yellowish orange hue. Two minute prominences were budding from the lower extremity.

At 9 P.M. the same day, twelve hours after the former observation, its appearance was as fig. *c*; differing from the former by the nucleus being a little more condensed, and by the prominences having increased to two divergent roots, each nearly as long as the body.

The next morning at 9 A.M. a more decided change was manifest. A third rootlet had projected; and the body, which was lengthened, stood up from the face

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Vincent Brooks Imp.

Metamorphosis of Clavelina.

of the glass so distinctly that I carefully detached it, without injury (except to the rootlets), for examination with higher powers. All the essentials of an adult *Clavelina* were now developed. (See fig. *d.*) The branchial sac had two rows of oval ciliary cells; the stomach, the ovary, and the heart were perfectly defined, and the last-named organ was performing its periodical pulsations with beautiful regularity. The buccal and the anal orifices were indicated by prominences on the anterior end of the mantle; but these were not in contact with the outer tunic (or test), which seemed as yet imperforate. As the circulation of the blood, however, was vigorous, I presume that it was oxygenated by general absorption through the tissues, since no currents could pass through the gill-sac.

My observations here terminated: but the further progress of the little animal would of course present no difficulty, but would be merely a gradual growth or development of the parts already formed.

There are probably other species than have been as yet recognised; for Mr. Dyster found and showed me specimens from the Caverns, which displayed important differences from this, as well as from all the other species described by M. Milne-Edwards, in his "Observations sur les Ascidies composées."

Plate V. represents a group of *Clavelina lepadiformis*, magnified. Two adult specimens are seen, with several young buds variously advanced.

Plate VI. represents the metamorphosis of the species, much magnified.

a. The larva in its free tadpole state.

b. The same, just become adherent.

c. The same, twelve hours later, with the root-thread increasing.

d. The same, after twelve hours more; the internal organization developing.

XIX.

SURFACE-ANIMALS.

Larva of a Crab—Comparison with Mr. Couch's Figure—Metamorphosis—Results of the Change—Circulation—Curious Vessel—Purple-ringed Medusa—Structure of the Eye—Prisms—Their Composition—Sagitta—Its Head—Spines—Digestive Canal—Fins—Eyes—Habits—History—Zoological Position.

July 15th.

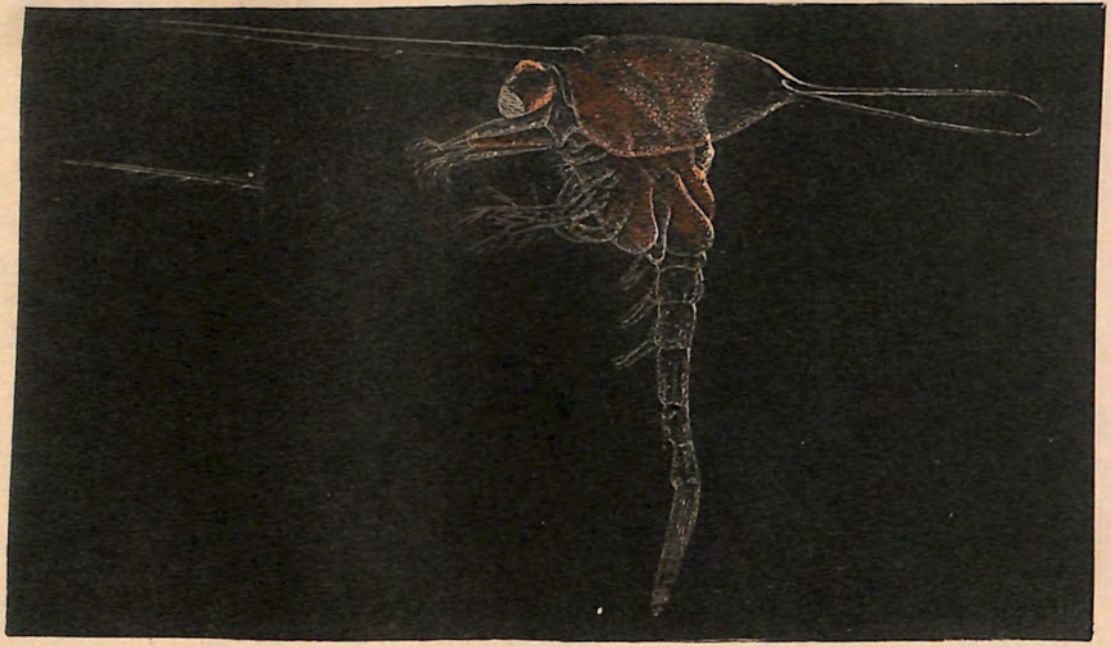
Among the surface-swimming creatures which the Medusa-net brought in, as we swept along from Tenby through the Sound which divides St. Margaret's Island from Giltar Point, were some half-dozen minute Shrimp-like Crustacea. (See Plate VII.) Examination showed them to agree in every essential point with the second or Megalope stage of *Porcellana platycheles*, as figured by Mr. Bell, after Mr. Couch, in Brit. Crust. p. lvi. *g*. Yet there were sufficient diversities in detail to prove that they were not specifically identical; and the metamorphosis of one which I witnessed induces me to believe that they belong to the genus *Galathea*.

Mr. Couch represents the long appendages to the carapace as flexible filaments: in my specimens they are certainly stiff, inflexible, and very fragile spines. The anterior one is quite straight, and nearly thrice

the length of the whole body from head to tail. It is beset, on various lines on its surface, with short slender spinules jointed to shoulder-like angles, and not serratures. Its interior is perforated by a canal, which dilates and narrows irregularly. The carapace posteriorly is not like that of Mr. Couch's figure. It is semi-oval, projecting a transparent convex vault far over the part where the abdomen is attached to it, as is seen when the latter bends down. Its extremity gradually tapers into two straight, sub-parallel, stiff spines, about as long as the carapace itself, each terminating in a hooked point.

The abdomen ends in a spinous plate, but this is much more elegantly lozenge-shaped than in the figure alluded to; and the spines are set on differently. Each of the two latero-posterior edges of the lozenge is cut into six rectangular teeth; and each tooth bears on its hinder face a long spine articulated to it, and most delicately plumose all along its sides. The hindmost pair of spines are short, and are set close together, side by side. Besides these jointed spines, each lateral angle of the caudal lozenge projects into a spine-like tooth.

Though the individuals were all in the same state, as to development, there was some difference in size. I took them one by one, with a glass tube, out of the vase in which they were, to put them into a glass trough for microscopical examination. The largest, during the few seconds which were occupied in the process of dipping out the next, *underwent a metamorphosis*. I had observed that, after skipping about



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Vincent Brooks Imp.

Pupa of Galathea.

the trough for a few moments, it sank quietly to the bottom, where it lay on its back; the next thing that I saw was a much more Crab-like animal (see Plate VIII.), more opaque, redder, much larger, but lying on its back, in the very spot where a moment before I had seen the Megalope; while close by it lay the transparent filmy skin of the exuviæ.

The new animal was evidently now in its final state, needing only development of its parts, which it would obtain by successive moults, to acquire the adult form. It seemed to me, however, that that form was certainly that of *Galathea*, not of *Porcellana*.

I submitted the exuviæ in detail to a power of 220 diameters, and thus obtained most of the particulars of structure mentioned above. But the slough of the eyes presented one of the most exquisite microscopic objects that I have ever beheld. They are somewhat pear-shaped, with the facetted portion well-defined. It was the appearance of these facets, varying according as the perfectly hexagonal outline of each, or the smooth and glossy convexity, came into focus, that was so peculiarly charming.

Afterwards examining a living Megalope, I saw that the three pairs of pencilled limbs did not represent any of the true legs; for the transparency of the integuments allowing the interior to be clearly seen, and the organs of the imago being matured and just ready for sloughing, I perceived with the most beautiful distinctness the fingered claws (short and stumpy, it is true, as compared with their perfect form in the newly freed imago), folded down upon the breast within the skin, the second pair as large, and traces

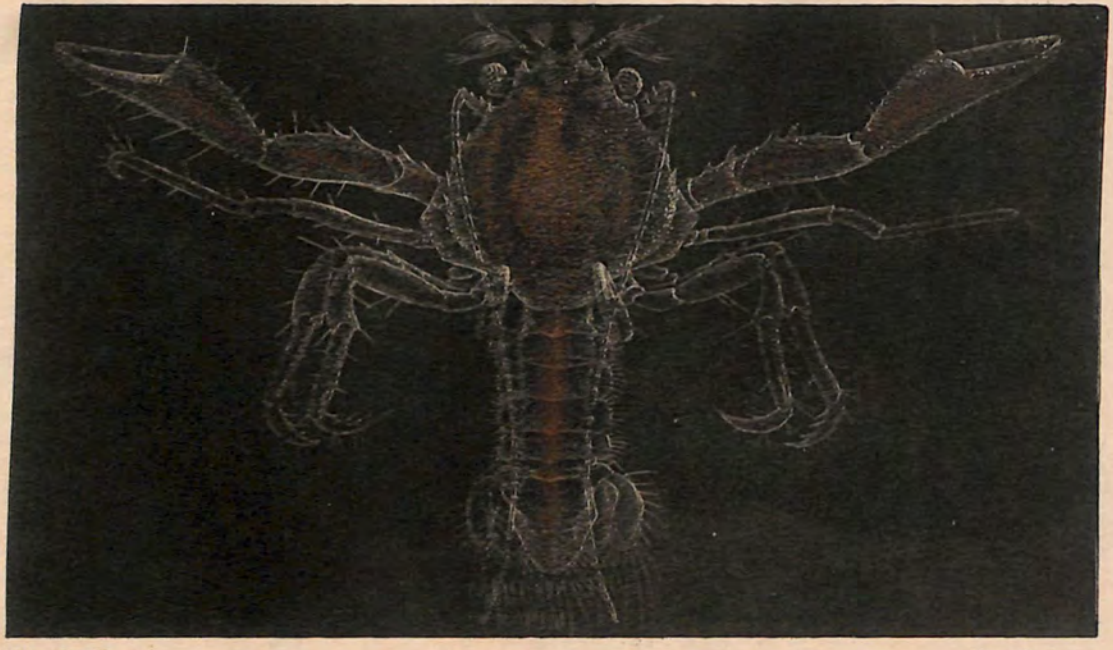
of others beneath them,—all these forming two great projecting lobes, slightly moveable beneath the thorax of the Megalope. Of these lobes, however, which occupy a bulk nearly equal to the whole carapace, not a trace exists in Mr. Couch's figure.

The circulation was beautifully clear. The pellucid colourless globules chased each other by starts to and fro, as the eye rested on the afferent or the efferent current. It was distinct in some parts where I should scarcely have looked for it; as all over the lozenge-plate of the tail, in the interior of the eyes, throughout the posterior spines of the carapace, and the frontal spine. But besides, and apparently independent of the circulation, there was a singular fusiform vessel in the latter segments of the abdomen, penetrating the tail-plate, on the ventral side. This vessel, now and then, irregularly, dilated quickly, and closed; the wave proceeding upward toward the head, but only for a short distance, and unattended with any impulse to the blood-globules. It could hardly have been a superficial fissure.

The figure in Plate VII. was taken from a Megalope, scarcely dead, for the circulation was still proceeding.

That in Plate VIII., from the Imago, after death. Both figures are much magnified.

In that singular recess near Lidstep, that, as I have said, resembles the unroofed area of some vast Cyclopean palace, I saw floating in the crystalline deep several specimens of the well-known Purple-ringed Medusa (*Aurelia aurita*). Having dipped up,



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Vincent Brooks Imp.

Young Galathea

in my muslin net, a specimen, which I brought safely home, I took the opportunity of examining the structure of the eye in this very common species. It agrees essentially with that of *Chrysaora*, *Pelagia*, and *Rhizostoma*. Each ocellus consists of a minute sac-like vesicle, pendulous from the margin of the umbrella, but placed within a cleft, and protected by certain veils or folds of gelatinous membrane. It presents a beautiful appearance, viewed as an opaque object under strong light; for the sac is completely filled with prisms of crystalline substance. When crushed between plates of glass, or by the graduated pressure of a compressorium, the individual prisms become scattered and confusedly heaped together, and present themselves to the beholder under various angles; so that the great majority appear of undefined form, and resemble grains of fine siliceous sand. But still many among them exhibit a perfectly regular shape, and, whether viewed vertically or laterally, are seen to be short truncate columns of six equal sides.

Before any injury has been suffered by the sac, or any distortion of the position of the prisms has occurred, they lie with their truncate ends at the exterior surface of the mass, so that they must be considered to radiate from a centre. Yet it is difficult to suppose such an arrangement unless they were cones (which they do not appear to be, but hexagonal cylinders), or unless their extremities left considerable interstices, which certainly are not visible, the polygonal sides appearing to be in contact. The close resemblance which the glistening globe of

hexagonal prisms bore to the facetted eye of a dragon-fly or other insect, forcibly struck both Mr. Dyster and myself, and failed not to suggest interesting comparisons.

The act of crushing the eye with a plate of glass appears always to fracture many of the prisms; and from the appearance of these, as well as from the close examination of the direct ends of such as are whole, I feel sure that they are composed of concentric layers around the longitudinal axis, which occasionally has the aspect of being finely perforate. There are also occasional traces of a lamellar structure, transverse to the long axis; but this is more obscure.

Very many, but not all, of the prisms exhibit a well-defined distinct square mark, which I believe to be a cavity in the very centre; but Mr. Dyster thought it superficial. The extreme delicacy of focusing requisite for the decision of the question, under the high powers which were used (such as 550 diameters), prevents my speaking positively on this point.

The prisms vary exceedingly *inter se*, both in length and diameter; the smallest appear to be situate near the basal part of the pyriform sac.

It does not appear that these bodies are siliceous, as Professor Forbes suggests on the authority of Rosenthal,* or that they are crystals of earthy matter at all; but rather that they are composed of hard, transparent, organic tissue, analogous to the crystalline lens in vertebrate animals. When treated with

* Naked-Eyed Medusæ, p. 9.

Liquor Potassiæ, they speedily became amorphous, and dissolved into a turbid fluid. Another lot, immersed in Nitric Acid, dissolved in like manner, acquiring a slight tinge of green during the process. Not the slightest effervescence or disturbance was visible by the most careful watching under either treatment.

In dipping for *Medusæ* with a surface-net on this coast, as well as off the harbour of Ilfracombe, I have taken in considerable abundance a minute translucent animal, which is one of those debatable forms that mock our systematic classifications. At first sight it bears so striking a resemblance to a miniature fish, that one is ready to conclude it the newly-hatched fry of some small species; but, on microscopical examination, the structure of the head absolutely precludes such a supposition.

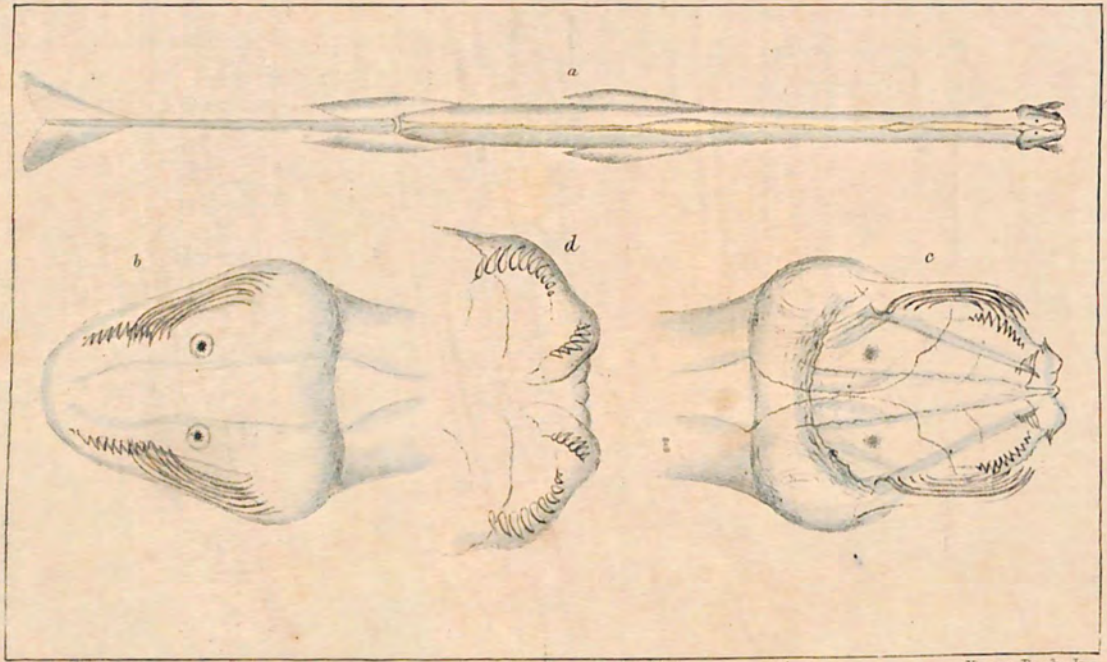
The animal is very slender, its greatest thickness, in the specimens that I have seen, being not more than $\frac{1}{25}$th part of its length, which latter varies from one-fourth to three-fourths of an inch. The form (see Plate IX. fig. *a*) is almost cylindrical; but at the distance of nearly three-fourths from the head, it diminishes, somewhat abruptly, to about half the former thickness. The whole animal is diaphanous, and almost colourless.

The head, which is the most singular part of this little creature, is in form not unlike that of a snake (see *b* and *c*), being somewhat heart-shaped in vertical outline, with the hind-head forming two rounded lobes, and flat when seen sidewise; but here the resemblance

ceases. The sides of the crown of the head are formed by two slender *bones* (if I may familiarly call them so), or pieces of apparently cartilaginous consistence, which approach each other in front. To the outside of each of these is articulated a series of crystalline spines, curved in a scythe-like form, sharply pointed, and set parallel to each other, like the bent fingers of a hand. (See *c*.) Each series consists of ten of these scythes, which move together, opening and shutting horizontally, or nearly so, like a pair of shears, or like the jaws of a beetle. The whole apparatus, when widely gaping and forcibly closing, looks truly formidable; and reminded me of a horrible instrument of Papal cruelty which I have read of, as used in some German cities during the middle ages, which consisted of a number of scythe-blades set in opposing rows, and worked by machinery across each other.

The scythes of our little "fish" do not, however, cross each other; but the points of each series work across the points of a like number of teeth set in a semicircle near the front angle of the head, and pointing downwards. (See *c*, *d*.) Besides these, there is another series of five teeth on each side, set at the very extremity of the upper jaw: (See *d*.) The front of the head is formed by an upper and an under lip, both of which are cleft.

The array of spines and teeth, formidable as it looks, appears to be an instrument of capture and prehension, and not of laceration; the prey seized being received entire into the mouth, which is narrow and tubular; whence it passes through a constriction



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Vincent Brooks Imp.

The Sagitta.

into the digestive canal. This is a simple tube* running in a straight line through the greater part of the length, with occasional fusiform enlargements, remote from each other. The last of these swellings is very small, and passes through a substantial diaphragm, placed just at that part where the thickness abruptly tapers to the tail. (See *a*.) The excretory orifice appears to be situate below this diaphragm. Thence to the extremity a fine line, the edge of a vertical membrane, divides the body into two equal portions.

The fish-like character of this minute animal is heightened by a finny expansion on each side of the tail, forming two triangular ample lobes, and consisting of a subtile gelatinous membrane supported by a vast number of diverging cartilaginous rays, of the most delicate tenuity, and set very close together. They appear to be brittle; for the points of many are frequently broken off, or bent up with a sharp angle, though not separated. This caudal fin resembles that of a dolphin rather than that of a fish, in its form; and also in its position, being set on horizontally to the plane of the body, and not vertically like a fish's tail. Two other fins of exactly similar structure are placed on each side of the body, expanding horizontally. The middle of one pair is opposite the diaphragm; the other pair is about midway in the total length. They appear to me to terminate posteriorly with a sharp angle; but the extreme delicacy

* I have never seen the digestive canal other than empty; but Krohn describes it as occasionally containing fragments of small fishes and crustacea, and even of other *Sagittæ*.

and transparency of the membrane preclude my being absolutely positive on this point.

The upper side of the head is furnished with two eyes (see *b*), each of which is seated on the surface of a clear globose body, probably a ganglion. The eye consists of a pupil of black pigment, rather square in form, surrounded by a circle of very minute crystalline lenticular bodies.*

The little animal moves by fits and starts, vibrating its neck and tail, with a rapid jerking or quivering action, somewhat like that of the tail of a fish when it darts through the water. In like manner, our little creature shoots along for a short distance at the same instant; and when the impulse is exhausted, it remains still, until another fitful vibration sends it onward. The neck is frequently bent abruptly to either side.

Under the microscope, the jaws are, every now and then, suddenly thrown open and shut with a snapping action, as if seizing prey. It is not kept alive long in confinement; of the numbers that I have taken, none lived much more than a day.

Having thus enumerated the particulars which I have personally observed in this very curious animal, I will briefly add what I have learned of its history from other sources. It was first seen and described in 1781 by the name of *Sagitta bipunctata*, and several other species have been since added to the genus. Its very anomalous character has given it a

* According to Mr. Huxley, these crystalline lenses, or *corneæ*, are disposed in three distinct sets; but in such as I have observed, they form an uninterrupted circle.

great interest among zoologists; and elaborate investigations have been made into its structure and relations by Messrs. Krohn, Wilms, and Busch, among the continental zoologists, and by Mr. Huxley in our own country.*

In the general form of the body, the relative proportions of the two pairs of fins, and particularly in the form of the tail-fin, which was forked, my specimens differed from those which have been described under the name of *S. bipunctata*. These differences, however, may have depended on the immaturity of the individuals examined; especially as I did not detect the ovaries which are described as occupying the hinder part of the body in front of the diaphragm.

The natural position of the genus in a zoological system, is still a subject of much uncertainty. It has been placed among the MOLLUSCA; but that view seems now to be pretty well given up. Common consent seems to refer it to the ANNULOSA; but in what particular class is doubtful. Mr. Huxley ingeniously suggests† its affinity to those singular fresh-water members of the Class ARACHNIDA, the *Tardigrada*—those sluggish bear-like creatures, with four pairs of rudimentary feet, armed with terminal hooks, that are found in the sediment of ponds;—"the rudimentary feet with their hooks being [in the course of the development of the young] thrown up to the region of the head;" and forming, I presume, the six series

* Very recently the results of these investigations have been digested into an able Memoir on the genus, by Mr. Busk, in the Journal of Microscopical Science, for October 1855.

† Rep. Brit. Assoc. 1851, p. 77.

of teeth above described. Fatal to this suggestion, however, is the observation of Gegenbaur,* that the young leaves the egg, presenting, in every respect, the characters of the adult *Sagitta*.

Plate IX. represents *Sagitta bipunctata*, and some of its anatomical details.

a. The animal seen vertically, magnified.

b. The head seen from above, with the jaws closed.

c. The head seen from beneath, with the jaws slightly open.

d. The fore part of the upper jaws, showing the two series of immoveable teeth.

* Sieb. and Köll. "Zeitschr.;" 1855, v. 15.

XX.

THE SUCKING-FISH.

Two-spotted Sucker—Its Minuteness—Beauty—Parental Care—Eggs—Birth of Young—Its Appearance under the Microscope—Blood Circulation—Interest of the Spectacle.

July 16th.

THE little Two-spotted Sucker (*Lepidogaster bimaculatus*) that I dredged a few days ago, has afforded me some entertainment. It is one of the smallest of British fishes; this specimen, which is rather above the average size, being scarcely more than one inch and a half in length, and less than half an inch wide in its greatest breadth. But it is a pretty little creature at all times, and this individual is prettier than usual, the whole upper parts being quite white, slightly mottled by evanescent specks, while the under parts are pale purplish, the two lines divided abruptly. On each side there is a dark purple oval spot, surrounded by a white ring. The eyes, which, as I have elsewhere stated, move independently, are particularly beautiful, resembling turquoises set in sockets of gold.

It is the habit of this tiny fish to lay its eggs in the interior of old shells of bivalves that lie on the bottom;

and it would appear that it is one of those species which exercise a parental care over their offspring, watching the eggs until the young are hatched. We can scarcely call it incubation; but the little animal coils itself up among its spawn, adhering by the sucking disk of its belly to the interior of the shell, and continuing there with remarkable pertinacity. I have kept my specimen now for seven days, during the whole of which time I do not believe it has left the old cockle-shell even for a moment, night or day, though it frequently shifts its position a little, now and then shuffling half round. Yet its quarters seem none of the most comfortable; since it finds room to sit only by coiling its tail on either side by its body.

The embryos have continued to be matured from day to day. On the first introduction of the nest from the depths of the sea to the light and warmth of a vase in my window, they came out numerously and rapidly; but after the first day the births were much less frequent. Now, however, on the seventh day of captivity, there is again an impulse to the process, and the remaining eggs are hatching fast.

The eggs are interesting objects beneath a lens. At first it seems as if each contained only two black specks, in a globule of pellucid greenish jelly; but on closer attention we perceive, through the perfectly transparent egg-shell, the form of the little embryo fish. It is coiled up in a circle, the centre of which is occupied by the head; and this, which is by far the largest portion of the animal, consists almost entirely of the two staring eyes. As soon as the young escapes, it swims along by a wriggling motion, usually seeking

the surface of the water, and that side of the glass which is next the light.

I put one into the live box of the microscope, and examined it with a power of 220 diameters. The eyes had the appearance of gems of a brilliant bluish-green colour, the rays being highly refracted and much shattered, or as if the eye were facetted; though this appearance seemed dependent not upon the surface, but upon the internal texture. The expansion and contraction of the heart were distinct; and the circulation of the blood-corpuscles, both arterial and venous, was beautifully visible, though they did not display any appreciable redness. I could trace the course of the blood-currents very clearly, as they passed to and fro along the gill-rays. Some distance behind the heart, a large bladder filled with a fluid of a pale green hue was conspicuous in the general colourlessness of the body; it was doubtless the gall-bladder. The whole body was translucent, but studded with black specks, each consisting of a number of vermicular black lines diverging from a central dot. The lower jaw displayed a single marginal series of teeth, set in close array.

There was something very interesting in being thus enabled to examine the intimate structure of an animal so highly organized as one of the Vertebrata. The organization comes so near to that of our own bodies, as to call forth a closer sympathy in one's feelings, than in viewing those subjects which are commonly placed on the stage of the microscope. It was not merely the examination of vertebrate tissues: the functions of life, of *vertebrate* life, were going on

in their due course; and the viscera and other internal organs were plainly revealed in their proper places and relations to the general whole, while yet their vital operations were uninterrupted. The sight seemed a comment, more than usually striking, on the admiring remark of the inspired Psalmist,—"I will praise Thee, for I am fearfully and wonderfully made!" (Ps. cxxxix. 14.)

XXI.

TRAWLING.

Trawlers getting under Weigh—Stern Necessity—Particulars of the Enterprise—Description of the Craft—The Trawl—Beam—Heads—Trawl Rope—Pockets—Bridle—Warp—Cost—Process of Trawling—The Haul—Disposal of the Fish—Rubbish—Its comparative Value—Apathy of the Trawlers—Disappointed Expectations—Plumularia—Leafy Sea-mat—Its Odour—Number of Cells—Spines—Coverlid—Lip—Polype—Avicularium—Its Movements—Provision for their Freedom—Papery Sea-mat.

July 17th.

I LIKE to stand at our parlour-window, and see the Trawlers getting under weigh on a Monday morning. The dark red sails are shaken out, and lie awhile flapping against the booms; while the voices of the men, half song half cry, "Ho! heave ye ho!" heaving up the anchor, come mellowed and softened by distance on the ear. Next comes the harsh creaking of the gaff upon the mast, as the mainsail rises up, and up, and up, till it is "all taut;" up goes the jib, and out glides one snug little craft. She creeps round the pier-head, hauls her wind and makes a traverse or two, and is lost to sight as she rounds the Castle Hill. One, and another, and another follows; and in a few minutes, the little harbour, that was crowded

with tall masts, is left empty, except for a punt or two, and the unwieldy lighter that is unloading yonder steamer.

Then I walk into my little study, and take my stand at another window which overlooks the sea and St. Catherine's. Presently the fleet appears, from behind the Head, all close-hauled, standing away to the southward, each the very counterpart of all the others, all under the same canvas, mainsail, gaff-topsail, foresail, and jib. The morning sun gleams brightly on the brown sails, but the sea is green and wild, and the sky behind them of the hue of indigo. Everything threatens a gale from the southward, but the bold fellows hear the call of duty and dare the danger. Who will give their wives and little 'uns bread next week, if they bring in no cargoes of gurnards and thornbacks on Friday night? Jack knows that will never do; so he ejects his tobacco-juice to leeward, takes an additional tug at his trowsers, and is off (to use his own felicitous simile) "like a shot out of a shovel."

Now St. Catherine's cliffs shut them in; and when they reappear on the other side, they are so far out in the offing as to be but brown specks. Farewell, ye bonny little sloops, till I see you return with a load of fish that shall put ye "gunwales under," a'most. Meanwhile I will go and chat with that old salt that is sitting on a balk of timber on the quay, enjoying the genial sun. He has trawled many a voyage out of this port, and he shall tell me all about their goings on.

About five-and-twenty or thirty vessels compose

the fleet which make this little harbour their head-quarters during the season. For the most part they are Brixham craft, a few only belonging to this vicinity. The large capitals that we see painted so conspicuously, in white upon the black bulwarks, indicate their respective homes; the initial and final letters of the place being expressed. DH. is for Dartmouth, whence the Brixham men generally hail; TY. shows that two or three are owned at Tenby; and occasionally MD. for Milford, or SA. for Swansea, point to the west or east of this place. The Ilfracombe boats work on this side, but seldom run in, except under a strong south-east gale. All the vessels are sloop-rigged; clean, well-built boats of about thirty tons each, fast-sailing, yet comfortable; an important item to the crew. Some of the new clippers are faulty in this respect: everything being sacrificed to speed, there is no comfort for the men in bad weather.

As they lie in harbour, and as they run away to sea, we see the trawl hoisted up to the mast-head, whence it depends to the vessel's side. The trawl is a net of conical form, running off to a point; it is about twenty-five feet wide, and thirty-five feet deep. The upper edge of the mouth is fastened to a stout *beam* of fir-wood, twenty-five feet long, the ends of which carry the *trawl-heads*. These are stout flat bars of iron bent into a semicircle of three feet wide, to keep the foot of the trawl (or that part of the net which is to drag over the sea-bottom) that distance below the beam. To the curve of each *head* is fastened the *trawl-rope*, which is so loose as to recede in a curve-

line to half the length of the trawl; it is a stout rope well "served" (or coated) with spunyarn for preservation. Within the bag of the net are *pockets*, which open backwards. To each end of the *beam* is affixed a stout rope, coming to a point in front, and thus forming a triangle with the beam for its base: this line is the *bridle;* and at its point it is connected with a strong pulley (the *warp*) by means of a block. The *warp* is made fast on board, and it is by hauling on it that the net is drawn in for examination. A new trawl costs £50 or £60, and the boat is worth about £700.

When the fleet has arrived at the trawling ground—which may be this side of Caldy, or on the outer side, or in Tenby Roads, or even farther out to sea—the trawl is hove over the side, and the vessel runs free, or goes on a wind for six or sometimes twelve hours. Now what I have said of the construction of the apparatus will enable you to understand its mode of working. The weight of the whole affair, especially of the iron *heads*, carries it speedily to the bottom; the buoyancy of the fir *beam*, however, keeping that, and consequently the upper edge of the net, free from the ground. The way of the boat now hauls upon the *warp*, and through it upon the *bridle*, which drags the beam along transversely to the course. The net then trails along behind, the *trawl-rope* dragging the bottom in a curve, extending some twenty feet behind the *beam*.

Multitudes of fishes of different kinds are lying quiet, or feeding, on the bottom: the *rope* sweeping along disturbs them, and their first impulse is to

dart upward from the annoyance. But, in so doing, they come in contact with the net, which is like a roof over them. They must then shoot along horizontally: if they go one way, they are in the bag of the net; if the other, the pockets which are hanging down receive them; if they sink again, the *trawl-rope*, which is constantly advancing, has carried the bottom of the net beyond them, and they are completely taken. It will be manifest, of course, that only certain kinds of fish can be taken by the trawl; mackerel and herring, that swim in shoals at the surface, are secure from its meshes; but gurnards, red mullet, the different sorts of skate, with turbot and flounder and brill, and other flat fish, the habit of which is to haunt the bottom of the sea, fall a prey to the ingenious device.

At the proper time the trawl is hove up by a windlass in the forepart of the vessel, and a winch aft. The net is partly hauled aboard, so as to get the contents fairly down into the point or *cod* of the net. I ought to have said that the extreme end is not a *cul de sac*, but is left open; a line being tied tightly round, a little way from the tip, when it is put overboard. The fish then being all down in the *cod*, a line is passed round above them, and, being made fast to a tackle, the bag is hoisted on deck. The lashing at the point is now untied, and out falls the whole gathering on the deck. Then it is fastened up again, and the trawl lowered for another haul, while this is attended to.

The best sorts of fish, as turbot, sole, &c., are at once debowelled, washed and packed in baskets, and

stowed in the hold; while the coarser kinds, as ling and hake, are thrown in, "in bulk," or loose. When all that the fishermen esteem—that is, all that possesses a monetary value—has been thus cared for, the rubbish is swept overboard with as little delay as possible, the decks washed down, and all made ready for another haul.

It is found mutually advantageous that the trawlers should associate themselves in companies, or, as they term them, "sides." Four boats go to a "side," of which one (in turn) every day carries the produce of the whole "side" to market. When I just now sent after the departing fleet my wish to see them return deeply laden, I spoke without knowledge. It is not the custom to do so. Fish is peculiarly perishable; and, if allowed to lie in the close hold of the boat for four or five days, would be anything but welcome to the good people of Tenby. Besides, there is here no sufficient demand for the yield; more extensive markets must therefore be sought for it. The chief of these is found at Swansea; and every day a boat from each "side" runs up to that port with her load of fish, perhaps £8 or £10 worth, and returns to her companions to resume her place in the labours of trawling, while another becomes the carrier. Sometimes a load is shipped by steamer to Bristol; while, of course, sufficient is reserved to supply Saturday's market at Tenby.

Such, then, is the process of trawling; and you will readily suppose that so extensive a sweeping of the sea-floor as this involves must present unrivalled opportunities of gathering the *opima spolia* of marine

natural history. And so doubtless it would, if the trawlers had intelligence or taste to avail themselves of the riches thus poured at their feet. It makes a naturalist's mouth water only to imagine to himself the nature of the "rubbish," which is unceremoniously swept overboard after every haul. The multitudes of minute Fishes (which, being uneatable, are valueless); the fine and rare Shells, both univalve and bivalve; the strange Ascidians; the Crustacea and Cirripedes; the elegant Worms and other Annelides; the Sea-cucumbers, Urchins, and Stars; the Medusæ, great and small, covered- and naked-eyed; the Corals, the Anemones, the Sea-pens, and Sea-shrubs, and numberless other unnamed and unnameable creatures, things on which the eye of no naturalist has ever yet rested; —the multitudes of these that are every day trampled under foot, and thrust out of sight at the point of the besom, would, I suspect, be enough to keep the "Annals," the "Zoologist," the "Naturalist," and all our other scientific periodicals, full to overflowing with novelties, for many a long day to come.

It is exceedingly difficult to induce the trawlers to bring any of their "rubbish" home. Money, that in general "makes the mare to go" in any direction you wish, seems to have lost its stimulating power, when the duty to be performed, the *quid pro quo*, is the putting of a shovelful of "rubbish" into a bucket of water instead of jerking it overboard. No, they haven't got time. You try to work on their friendship; you sit and chat with them; and think you have succeeded in worming yourself into their good graces sufficiently to induce them to undertake the

not very onerous task of bringing in a tub of "rubbish." But in nineteen cases out of twenty you are disappointed.

The thing is not, however, utterly hopeless. Occasionally I *have* had a tub of "rubbish" brought to me, but much more generally worthless than otherwise. The boys are sometimes more open to advances than the men, especially if the master carries his own son with him, in which case the lad has a little more opportunity to turn a penny for himself, than when he is friendless. If ever you should be disposed to try your hand on a bucket of trawler's "rubbish," I strongly recommend you, in the preliminary point of "catching your hare," to begin with the cabin-boy.

A basketful of saved material thus brought in I have just been overhauling. An immense heap it made, when turned out on a board, but sadly disappointing when it came to be examined. It consists almost exclusively of one or two kinds of Hydroid Zoophytes, and these of the commonest description. It does not follow from hence, however, that an intelligent and sharp-eyed person would not have succeeded in obtaining a far greater variety; scores of species were doubtless brushed overboard when this trash was bundled into the basket: but being small, or requiring to be picked out singly, they were neglected; whereas these long and tangled threads could be caught up in a moment, like an armful of pea-haulm in a field, its value being estimated, as usual with the uninitiated, by quantity rather than quality, by bulk rather than variety.

Of what is brought in, in this manner, perhaps four-

fifths usually consist of *Plumularia falcata*—a rather rigid, but slender species, devoid of elegance. Its stem is a wire-like thread some eighteen inches long, but growing in a wide and loose spire, set at remote intervals with stiff branches, which are broadly feathered; the branches, both primary and secondary, carrying the polypes with their cells. The wide open character of this zoophyte, its rigidity, and the form of the feathery branches, all arching outwards, cause the specimens to be inextricably intertwined together; so that, by catching hold of two or three in your fingers, you might lift the whole tangled mass.

On the ova of this species Professor Grant has made some curious observations. "On placing a vesicle with its two ova under the microscope, we perceive through the transparent sides the cilia vibrating on the surface of the contained ova, and the currents produced in the fluid within by their motion. When we open the vesicles with two needles, in a drop of sea-water, the ova glide to and fro through the water, at first slowly, but afterwards more quickly; and their cilia propel them with the same part always forward. They are highly irritable, and frequently contract their bodies, so as to exhibit singular changes of form. These contractions are particularly observed when they come in contact with a hair, a filament of conferva, a grain of sand, or any minute object; and they are likewise frequent and remarkable at the time when the ovum is busied in attaching its body permanently to the surface of the glass. After they have fixed, they become flat and circular; and the more opaque parts of the ova assume a radiated appear-

ance; so that they now appear, even to the naked eye, like so many minute grey-coloured stars, having the interstices between the rays filled with a colourless transparent matter, which seems to harden into horn. The grey matter swells in the centre, where the rays meet, and rises perpendicularly upwards, surrounded by the transparent horny matter, so as to form the trunk of the future zoophyte." *

Of the remainder, a large portion is made up of *Sertularia argentea* (or *S. cupressina*, for they are scarcely separable as species), which is indeed a very beautiful object, but which I need not dwell upon, because I have described it already, as occurring abundantly in the Third Cavern of St. Catherine's.

A few other Hydroids are intermixed in the heap, as *Plumularia pinnata*, two or three species of *Sertularia*, *Antennularia antennina*, and *Halecium halecinum;* and several kinds of Polyzoa, of which the most conspicuous is *Flustra foliacea*, with its large and flat fronds of pale brown. This is a very common object, being frequently washed up on every sea-beach; but, as it grows only in deep water, it is rare to see it alive. Everything that the trawlers bring in this way is pretty sure to be hopelessly dead, for they merely throw the heap into a basket or tub, and let it lie in sun and shower till they come into port; and he must be a hardy Polyzoon that could stand such treatment as that. However, we may see something to admire in our *Flustra*, dead though it is.

Here is before me what appears a much and irregularly cut leaf of some three inches in width, of a

* Edinb. New Philosophical Journal, vol. i.

firm papery consistence, and of an uniform pale umber-brown hue. (See Plate X. fig. *a*.) You would recognise it in a moment, as it is a constant constituent of those Sea-weed baskets that are sold in every marine watering-place. If we look closely at it, we see, even with the naked eye, that its surface forms a delicately minute network of cells, which feel rough to the touch.

This irregular fan-shaped leaf is the "polyzoary," or compound animal of the Broad Hornwrack or Leafy Sea-mat (*Flustra foliacea*); and every cell is the residence during life of an extrusile "zoöid," or polype-like individual, with ciliated tentacles arranged in form of a bell, like those of the Stag's-horn already described. (See *ante*, p. 74.) When fresh, the whole leaf has an agreeable acid odour, somewhat like that of the lemon-scented Verbena or Geranium, but less pure.

Under the microscope the cells (fig. *b*.) are seen to be disposed in nearly parallel rows; but so that those of one row alternate with those of the next, the middle of one cell being opposite the end of its right and left neighbours. They extend over the whole leaf, and on both its surfaces: the depth of two cells thus forming the thickness of the structure. The *Flustræ* which form but a single series, all opening on the same side of the leaf, have been separated by Dr. Gray to form the genus *Carbasea*.

The individual cells are shaped like a child's cradle; and if you will please to suppose some twenty thousand cradles stuck side to side in one plane, in the form I have above described, and then turned over,

and twenty thousand more stuck on to these, bottom to bottom,—you will have an idea of the framework of this brown leaf. And do not think the number outrageous; for it is but an ordinary average. I count, in an area of half an inch square, sixty longitudinal rows, each of which contains about twenty-eight cells in that space: this gives 6,720 cells per square inch on each surface. Now a moderate-sized polyzoary contains an area of three square inches; *i. e.* six on both surfaces; which will give the high number of 40,320 cells on such a specimen. Many, however, are much larger.

Each cradle or cell is of shallow depth, but the head rises considerably higher than the foot. The margin of the head is armed with four short blunt spines, two on each side, which stand obliquely erect, projecting outwards, over the middle of the next cell, which (in concert with the spines of that on the opposite side) they protect.

Suppose, further, that a coverlid of transparent skin were stretched over each cradle, from a little within the margin all round, leaving a transverse opening just in the right place, viz., over the pillow, and you would have exactly what exists here. There is a crescent-form slit in the membrane at the upper part of the cell, from which the semicircular edge, or lip, can recede, if pushed from within.

Suppose, yet again, that in every cradle there lies a baby, with its little knees bent up towards its chin, in that zigzag fashion that children, little and big, often like to lie in. But stay, here is a child moving! Softly! He slowly pushes open the semicircular slit in the coverlid, and we see him gradually protruding

his head and shoulders in an erect position, straightening his knees at the same time. He is raised half out of bed, when lo! his head falls open, and becomes a bell of tentacles! The baby is the tenant-polype!

"This is a very amusing romance," you say. Nay, it is no romance at all. If you will excuse the homeliness of the comparisons, I venture to affirm that a personal examination of the creature itself would justify their correctness, and you would acknowledge that they could scarcely be more apt.

As we glance over the aggregation of cells, even with a lens of low power, we perceive that on some of them are seated minute white globules, which look like tiny pearls. They are placed, without any regularity of arrangement, sometimes on two contiguous cells, but more generally scattered at intervals, more or less remote.

The old observers called these globules *opercula;* but Mr. Busk has shown them to be the representatives of the Bird's-head processes in *Cellularia*, &c., only modified in form.

Under a higher power, the globule is seen to be flat on the perpendicular side, which is turned toward the foot of the "cradle," and this flat side is a moveable door, with its hinge along the lower edge. The door is of a yellow hue (whereas the globule is of a pearly white), and during life it opens, gapes widely, and shuts with a snap, just as does the lower mandible of the "Bird's-head."

It appears to me that though the *avicularium*, as this organ is now called, is situated over the head portion of the cell, the cell which carries such a pro-

cess is always abortive, never carrying a polype, nor capable of carrying any. Some observers have indeed spoken of the opening of the mandible to allow the protrusion of the polype; but they have doubtless confounded the semicircular lip of an inhabited cell, with the mandible of the *avicularium*.

I observe that the spines are wanting on these avicularian cells; and, what is much more interesting, they are wanting also on the contiguous edges of the two cells that lie behind every such cell. The reason of this is obvious. The spines projecting obliquely across would interfere with the gaping of the mandible; and hence they are invariably removed! What a beautiful proof of design and forethought in so small a matter!

The opacity of this species renders it unfit for displaying the appearance and position of the living polypes; but these are beautifully shown in the delicate tiny *F. papyracea*, or Papery Sea-mat (figs. *c* and *d*), which is not uncommon on rocks, at extreme low water.

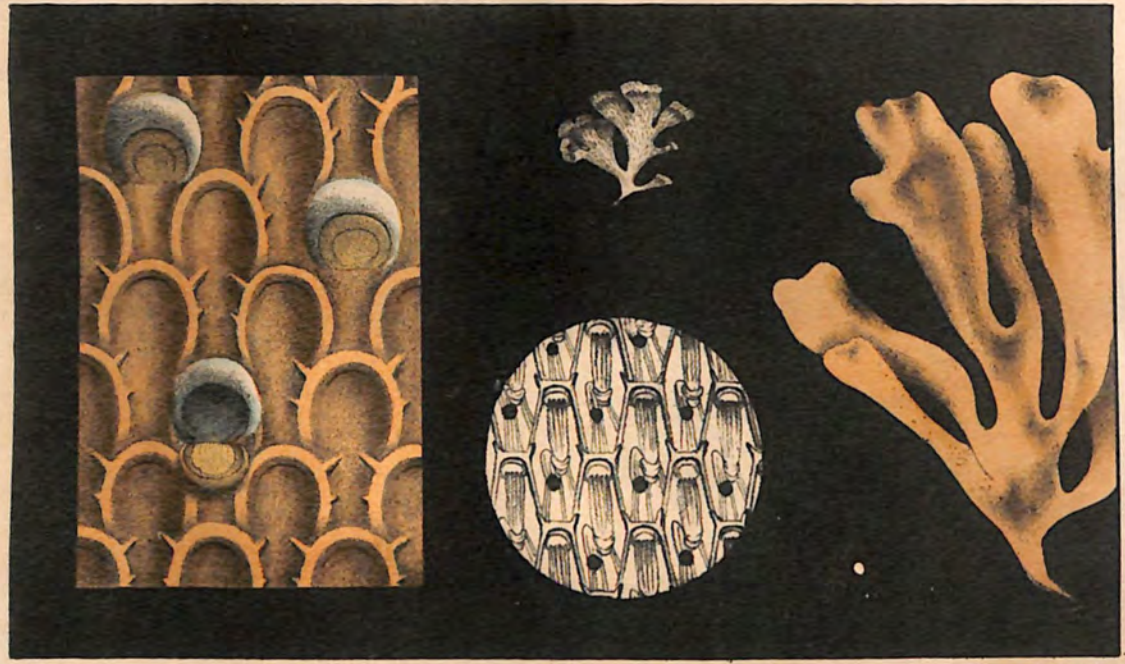
Plate X. represents the two species of *Flustra* abovementioned.

a. A specimen of *F. foliacea* of the natural size.

b. A few cells of the same; much magnified.

c. *F. papyracea;* natural size.

d. A few cells of the same; much magnified.



P.H.Gosse del et lith.

Vincent Brooks Imp

a, b. The Leafy Sea-mat. *c, d.* The Papery Sea-mat.

XXII.

BOG-BOTANY.

Early Morning — Haymakers — Birds' Songs — Wall-Ferns — Scotsborough — Musings — Gumfreston — Wells — Old Church — Churchyard—Botanical Excursion—Benet-herb—Lion's-tail—Cinquefoil—Sweet Gale—Penally Bog—Sedge Tussocks—Awkward Travelling—Marsh Pennywort—Osmund Royal—Meadowsweet — Asphodel — Skullcap — Bog-bean — Bog Pimpernel—Sundew—Superstitions—Legend of the Spell-bound Robber—The lost Watch—A Look at Scotsborough—In-door Trees—Garden—Retrospections baulked—Welsh Fires—Ball—Stumming down—Ball-making.

July 18th.

EARLY this morning I set off to walk out to Gumfreston, to breakfast with my excellent friend the Rector, as a preparation for a day's exploring. The air was fresh, yet warm and balmy, full of various odours, combined into a general sense of fragrance; little fleecy clouds, as white as snow, were sailing gently along in groups, like flocks of sheep, over a sky of the most lovely cobalt-blue; the close-shorn privet hedges that enclosed the gardens of some elegant villas, and the thick ivy on the walls, and the clustering foliage of the trees that drooped over into the highway, were glittering with dew-drops, sparkling in the level sun, that was soon to drink them up for his breakfast.

Groups of haymakers, with rakes on their shoulders, passed me on their way to the meadows; and their rustic bows and cheerful salutations were not less pleasant than their hearty merriment and snatches of rural ballads; while more delightful still was to hear the low sound of sacred melody, the tune of a hymn or psalm gently hummed by one solitary peasant with a meek countenance, as he went forth to his daily labour; one probably who had learned the happiest mode of giving expression to his peaceful joy.

"Nor will I to my labour go,
Or any work presume to do,
Till I have sought the God of heaven,
And my first morning's tribute given.

"Lest every bird's harmonious song
Reproach me as I walk along,
Thoughtless of Him whose sovereign power
Upholds and guards me every hour."

The finches, too, were chirping in every tree, and adding their little contributions to the praise of their Creator; and others were dusting themselves in the parched road; while the soft coo of the Woodpigeon came from a lofty tree.

My path at length opened into a road at a right angle, and fairly puzzled me to decide whether I ought to turn right or left. I caught sight, however, of Hoyle's Mouth on my left, or at least the abrupt ridge in which it is pierced; and as I knew that Gumfreston lay a good distance from that, to the north, I decided to take the right path; and I found it "right" in every sense.

The low wall of the road where it crosses the marsh

was almost covered with the tufts of Ferns, that sprang out from the old crevices. There were the young fronds of the common Polypody, cut into lobes of the brightest green; the small rosetted tufts of the Ceterach, all rough with the brown lines of fructification beneath; the elegant Wall Spleenwort, with its shining black stems and mid-ribs; and the unpretending Rue Spleenwort, so numerous as to fringe the lines of mortar with its little rigid fronds.

I pause to gaze on the ruined mansion of Scotsborough. The old ivy-clad crumbling walls are well situated, for the road takes an abrupt angle, passing partly round it at some distance, giving fresh views of the ruin; the green hill behind throws it well out, and clumps of wood and single trees alternately hide and reveal it. Between the high-road and the ruin is a breadth of marshy meadow, with a rushy stream meandering through it; cattle lie here quietly ruminating; but there is no sight of human habitation, no noise of human occupation, no sound of human voice, to disturb the repose that is so much in keeping with those old decaying halls.

These venerable ruins occurring at every turn give a very peculiar character to Welsh scenery. We see comparatively little in England that carries up our thoughts to remote antiquity; it is full of the life, the business, the enjoyment of to-day; and what we do know to be ancient is for the most part so connected with the present by perpetual use or inhabitation, that the wasting tooth of time has been met and opposed by constant vigilance, and counteracted by incessant renovation. In Wales we see also the present activity

of life; but it appears to be unconnected with that ancient life of which these crumbling mansions and castles are the silent memorials; as if there had been a sleep of a thousand years between the activity of the old and the activity of the new inhabitants.

Musing thus beneath the tall shadowing ash-trees that fringe the road, I came at length to the sweet little hamlet of Gumfreston, and to the hospitable house of its worthy Rector; than whom a Cockney visitor, such as I, could not desire a better cicerone, more stored with various learning and science, or more freely and kindly communicative of them. The ladies of the family are accomplished botanists; and so we planned, with another visitor or two, a regular invasion of Penally Bog.

But first there were many pleasant things to see in this little retired valley. We strolled to and fro through the well-filled garden, holding sweet discourse of heavenly things, the common faith and the common hope; and looked down from its fruit-laden trellises on the grey old Church in the dell, with its lofty square Flemish tower shooting upward from the dark-green embowering trees.

Then after breakfast we walked down into that ferny dell; pausing to turn aside to three wells of water so closely contiguous, that a child with his wooden spade could have made them all but one. The upper one contains pure spring-water; the next has been built up by art into the quadrant of a circle: this is a chalybeate, found to be exactly similar to that of Tonbridge Wells in its sensible and chemical properties. It deposits a floccose red sediment of

oxide of iron, and, as it bubbles up among the gravel, discharges great volumes of gas now and then. Below this is a third spring, also a chalybeate, but less impregnated; steps of worn masonry lead down to it, indicating its former reputation; but now it is never drunk, as the people have a notion that it springs out of the churchyard. Thence I was taken to see the Ash Well, another spring of purest water, and on to the venerable little Church.

This edifice is a curiosity: it is indubitably as old as the twelfth century; small and low, scarcely admitting a tall man to stand upright in parts; the smallness of the windows made it very dark even in this sunny morning;—what must it be in winter? The edifice seems to have suffered little change at the Reformation: the stone supports to the ancient rood-loft yet remain; there is a curious little mortuary chapel, with a vaulted and groined roof, and a pointed window: the basin for "holy water," of large dimensions, is built in the wall, projecting on the outside like a buttress; and there is a *piscina*, the concavity of which is elegantly fluted. The ancient hand-bell,—the *sancte* bell,—is also preserved; few of these relics remain in England, as they were in general destroyed or buried at the Reformation: this one, though cracked, is otherwise in fair condition.

I need scarcely say that these objects are considered with only an antiquarian interest: the Gospel of Christ is known and loved and preached in this little edifice, and these relics of old Popish darkness are of no further value than what they possess as illustrations of a former age. For my own private

opinion, even that measure of interest would scarcely induce me to tolerate their presence in a place appropriated to the worship of God.

The Churchyard, thronged with rude stones, lying or standing at all angles of inclination,

> "With uncouth rhymes and shapeless sculpture deck'd,"

brought Gray's "Elegy" vividly to my mind. Small as it is, it is a populous city of the dead; the resting-place of all the inhabitants of this village for seven hundred years! How many tender ties have been cut across, how many hearts have been broken, how many hopes have been crushed there! Even while I walked with my kind companion along the narrow path, the old sexton was filling up a grave, while the trees were shedding their unfaded flowers on the fresh earth, and scores of blackbirds were softly warbling their mellow notes from the sweet, retired bosky groves that encompassed us on all sides.

But the party are all waiting for our botanizing expedition; and now off we start, a formidable troop, well armed with pocket-lens and vasculum. We cross the fields to Penally Court. In the pastures there is a curious plant, very minute, with the leaflets of its compound leaves each marked with a purple spot, and its seed-pods twisted up in a spire so as to form a compact little ball, beset with long radiating spines. It is the Benet-herb or Spotted Medick, the desperate resource of the Woodpigeon, when the season deprives her of other food. No one can look at it, minute, hard, black, and well defended as it is, without feeling that the poor bird must be hard set

before it would resort to this, and justifying the distich that is current on Salisbury Plain, and perhaps elsewhere:—

"The gentle Pigeon knows no woes,
Until a beneting she goes."

By the horse-pond in the Court was growing a tall plant, not of the commonest, the Motherwort or Lion's-tail, with its crowded whitish blossoms; and we were no sooner entered on the edge of the Bog, than the Marsh Cinquefoil presented its dark purple flowers, and blackberry-like withered seed-heads. The Sweet-gale or Bog-myrtle was growing in great profusion,—a lowly shrub, like a minute willow, but most fragrant, especially when the leaves are bruised; a beautiful emblem of the Christian, who often needs to be pounded in affliction's mortar, before the odour of his graces will flow out.

"Gale from the bog shall waft Arabian balm."

In some parts of Scotland, the simple Highlanders use the twigs of this plant to make their beds; and here in Wales they offer it, as a token of kindly feeling, to strangers.

The perambulation of our ground was a matter of no small difficulty. It was an area of black soft mire, out of which grew great tussocks of bog-grass, —the Panicled Sedge, I believe. These afforded a firm support, when the foot was placed fairly on the centre of the tussock; but owing to the spreading of the grass on all sides, overarching the pits and ditches of mire below, it was not easy to know where to set down the foot. Many were the slips, many the

plunges, desperate the struggles; and what with the efforts of the gentlemen to help the ladies from tuft to tuft, their own herculean attempts at balance-keeping while they sustained the fair, their occasional tumbles, dragging their *protégées* into their own humiliation, the ups and downs of all, the screams, the laughs,—we became most uproariously merry. Grievously bemired of course we were: boots that had been lavender-coloured, looked as if they had been dipped into the blacking bottle, the polishing being omitted; and hose of snowy radiance were encased in sable mud. But we had come out to botanize, and botanize we would; we were out for a day's pleasure, and we were not to be disconcerted by a little bog-mire; especially as we were all manifestly in the same box. So we searched, and, searching, found. Found what? We found the Marsh Pennywort, whose peltate leaves reminded me of the Navelwort, only that they are more cut and less fleshy; still they have the same general resemblance to a plate, or still more to one of the cymbals that are used in military bands. And the Marsh Shieldfern, with winged feet, like the figures of the thievish god. And, what was better worth finding, the Osmund Royal, throwing up its flowering spike like a tall pyramid of chestnut-coloured blossom, so unlike our ordinary ferns, from amidst its magnificent fronds;—the noblest of our cryptogamous plants.

The little white clusters of the Water Bedstraw, and the spikes of the most fragrant Meadow-sweet, occurring together, reminded us of the customs of our ancestors, when these plants were much in demand

for strawing chambers, filling the place which is now yielded to carpets. Of the latter species old Gerarde tells us that "the leaves and flowers farre excell all other strawing herbes, for to decke up howses, to straw in chambers, halls, and banqueting howses in the somer tyme; for the smelle thereof makes the heart merrie, delyghteth the senses, neyther doth it cause headach or lothesomenesse to meate, as some other sweete-smellynge herbes doe."

The lovely spikes of small yellow lily-like flowers of the Bog Asphodel were interesting, as were also the pale crimson blossoms of the Lousewort or Tall Red Rattle; and perhaps more elegant than either was the Blue Skull-cap, which was springing out of the water of the ditches, and displaying the exquisite azure of its slender tubular blossoms. The Bog-bean, so much admired for its curiously-fringed white and red flowers, we unfortunately could not meet with in bloom, its flowering season being over; the large triple leaves, however, were abundant; as were also those of the fine Marsh St. John's-wort.

Not rare was that sweet little flower the Bog Pimpernel, the fac-simile of its bright ruddy-faced sister of the fields, except that it blushes more faintly. Dr. Johnstone, in his "Botany of the Eastern Borders," tells us that this was the "favourite flower" of Professor G. W. Arnott, who describes his *protégée* in the following charming manner:—"Yes! there is a tiny plant with a prostrate stem, as if unwilling to add to or detract from the beauty of the regular flowers which raise themselves on solitary slender stalks above the surrounding moss; it is of modest

pink, most delicately pencilled, not glaring red. Well do I remember the first time I collected the *Anagallis tenella,* five and thirty years ago, on Guillon Links. It was a rarity on the east coast, but in the west is very common: the island of Cumbrae I have long proposed to call the Anagallis Island; scarcely a bog but is covered with this flower: every summer it is more and more my delight. To the microscopist, too, it is a beautiful object, not only for the venation of the petals, but for the peculiarity of the hairs found on the stamens, the elegant structure of which has not, so far as I know, been hitherto noticed."

The peculiarity here spoken of is that they are divided into many joints, each joint being constricted in the middle, so as to make a series of knobs, like the antennæ of some beetles.

Finally, there was that curious plant the Sundew. It consists of a tuft of small stiff leaves shaped like a child's battledore, spreading on every side from the root; each of which is covered with short red bristles having globose heads. From these glands a clear fluid exudes, looking like tiny drops of dew, but which are tenacious and viscid as birdlime; and it is well ascertained that this substance detains flies and other insects that alight on the leaves. The plant called Venus's Flytrap, of North America, has a similar property; and it has been conjectured that the decomposition of the captured insects gives off gaseous or other elements which conduce to the health of the plant, as ordinary plants are fed by organic matters decaying in the soil. The curious fact stated by Dr. Lindley, that specimens of the Flytrap fed with

atoms of chopped meat have evidently thriven under the stimulating diet, and become more vigorous than others left to the resources of the soil and air, tends to confirm this supposition, however strange it may appear. The frequent occurrence of startling facts, facts at variance with pre-established theories, forbids the philosophic naturalist to speak of any statement, professing to rest on observation, as impossible, merely because it has not been hitherto recognised, or cannot be reconciled with existing knowledge. It was the remark of a sage—"The more I learn, the more do I become convinced that I know nothing."

Even bog-exploring tires at length, and we resolved, *nem. con.*, to return; the ladies leading us through some deep, narrow, bowery lanes, and across the fields by Trefloyne; where the large rose-like heads of the Musk Mallow flaunted, and the small white flowers of the Purging Flax were crowning their slender hair-like stems—the elegant little plant which is understood, on the best authority, to afford to the Fairies the material for the manufacture of their finest linen.

Incredulous indeed would he be counted who should dare to deny that the "good people" resort to these green lanes, or that they dance by the light of the silver moon on the smooth turf. These and similar superstitions linger among the peasantry here with a tenacious hold. Let me tell you a legend which I received from my friend the Rector, while walking home through these identical lanes, on this identical day.

"I wol you tel, as was me told also."

Some fifty years ago, a poor sailor from St. Florence went to Tenby to receive a small sum periodically paid him as a pension. Returning at night with the few guineas in his pocket, the clergyman of his parish overtook him, and they walked together. When they arrived at the bottom of the dell at Gumfreston, suddenly a voice from the ditch growled out, "Your money or your life!" and the poor mariner found himself seized in a sturdy grasp. Unwilling to part with his pittance, he struggled, and cried, "What shall I do?" The aggressor cursed and stormed, still demanding the money. At length the clergyman advised him to throw the guineas on the ground, which the poor fellow, seeing no relief, at length did, and, being released by the robber, went home bemoaning his hard fate.

In the morning, before day, the sailor hears a tap at his window—"John! get up, John!"

"O! what for, when all my money's gone? Why should I get up? Oh, dear!"

"Get up, John!"

"I suppose it's you, Mr. H. What's the use?"

"Yes, John; let us go and look if we can find any of the guineas left. Perhaps he didn't pick up all in the dark."

"O! do you think there's any chance?"

So the clergyman and the sailor went together, and got to the dell before day had broken. As they approached the spot, they heard in the darkness a groaning and a scrambling. "Oh, dear! please let me go! Oh, let me go! Forgive me, and I'll give up all the money! O Mr. H., do let me go!"

Conditions were made; the robber, who had been all night spell-bound by the magic power of the clergyman, was released; and John was bidden to pick up his guineas, and found them all right.

Such is the legend; which my friend received from the mouth of the brother of a high ecclesiastical dignitary in one of the Welsh dioceses. At the close, he said to his informant, who had told the tale with the utmost earnestness, "Do you believe it?"

"Yes, Sir," was the reply; "why not? Mr. H. was a scholard. You could do the same yourself, Mr. S., for you are a scholard too!"

This latitude of confidence in the supernatural powers of scholarship is not confined to Wales. One of my friends, a military officer at Ilfracombe, was one day overtaken by a poor woman, and accosted with this somewhat startling demand.

"O Sir, please tell me what has become of my watch."

"Your watch, good woman! How can I tell?"

"O yes, Sir! You're a gentleman, and I'm sure you're a scholard, and can tell all about it, if you will."

The poor creature actually followed him a long distance, in spite of all his repudiation of the necromantic art, begging and entreating him to tell her; and at last was fully persuaded that the will, and not the power, was wanting.

Returning from Gumfreston, I turned up a side-road, to have a closer look at the ruined mansion of Scotsborough. The road, though wide, had become,

from disuse, covered with grass and weeds, which reminded me strongly of the deserted highways in Jamaica. Few things, I think, impress the mind more with a sense of desolation than to see green roads; the ways made expressly for the track of man and beast, and which are by the ordinary traffic of life kept so utterly bare, reverted to the state of the untrodden field. One of the most graphic touches in those descriptions which have reached us of the desolate state of London at the time of the Great Plague, is that the grass grew in the chief thoroughfares.

When I got to the building, I was disappointed. Nothing of architectural beauty or splendour, no carved chimney-pieces, or massive windows, or domed ceilings, or tracery of stone, told of opulence and taste in the edifice when it was *alive*. It seems to have been a rambling farm-house, with a great many small rooms, put together on no plan at all; and would present little of present interest, but for the additions which Nature has made. Ash-trees of considerable size are growing in the roofless rooms; a striking feature, and one which again brought Jamaica vividly to my recollection—the boiling-house of Bluefields, and the figs and sour-sops filling it with their columnar trunks, and re-roofing it with their crowns of foliage. The ivy which grows within the walls here is remarkably fine; I observed several trunks nine inches in diameter.

An old-fashioned wicket led out into a large garden, choked up with great weeds. Thistles and Ragworts, Sow-thistles and Teasels, Docks and Mallows and

tall Umbelliferæ, were struggling for the mastery. "Coarse, very coarse!" I mentally observed, in the words of the complaining flunkey. Yet when I came to look, there were Violet plants growing on the borders, and Roses, both shrubs and standards, and Sweet-brier; and many Apple-trees covered with Lichens, and Bullace-plums overrun with hanging draperies of ivy. "How interesting," I thought, "thus to roam through a garden of a bygone age, and see the very fruit-trees and flowering-plants, the identical individuals that were planted by the hands, and refreshed the senses of the people who lived here centuries ago. For doubtless this garden is in the same state in which it was left when ruin fell on the mansion, untouched by any hand save that of Nature!"

I walked on through the choked garden-paths, and presently came to a strawberry-bed, not very weedy. "Dear me! this does not look so very old!" I looked up and saw a fine Virginian Creeper trailing up the mouldering wall, and worse—oh! worse than all—a *Fuchsia* in full blossom! I need scarcely tell you that my note-book was thrust into my pocket in an instant, and my coat buttoned up in indignation. All my sentimental dreams about the antiquity of the garden to be thus sacrilegiously broken by a paltry Fuchsia! I endeavoured to recover my equanimity by sitting down on the bank of a clear pool outside the house, beneath two shadowing ash-trees, and dipping for *Rotifera*.

The fact is, as I subsequently learned, that the garden has been imperfectly cultivated by a neigh-

bouring peasant; but it surely does not much honour to his culture.

I had an opportunity of seeing at Gumfreston, by favour of my kind friends, the ladies, who admitted me into that *sanctum*, the Kitchen, the curious manner of making the fire, peculiar to these parts. The servant had before her a quantity of "ball," a substance resembling black mortar. Of this she rapidly fashioned with her hands oval knobs of the size and shape of swans' eggs; a row of which she placed, all inclining one way, in the front of the fire-grate. On the top of this row another row of balls was laid, leaning the other way; then a third, the inclination of which agreed with the first, and so on until the wall was built up above the top bar. The middle was then filled with knobs rudely fashioned, and the whole was covered with rows of balls. I ought to have said that there was a smouldering fire left in the bottom of the grate, which had been burning all night; for the kitchen-fires here are never extinguished: in many houses they have been kept burning for generations. Though the balls were very wet, and had but just consistence enough to retain their form, they soon dried; and in about an hour the whole interior began to glow, and assumed an intense white heat, without flame or smoke, which, seen through the front balls, had a very novel and curious effect. If a great cooking had been contemplated, the maid would have fashioned her "balls" with more care, and given them a longer form, resembling that of sausages.

When the family retire for the night, the fire is

drawn together; a thick coat of wet "ball" is plastered over the top, in the middle of which a hole is then made with the poker to allow a draught. This process is called "stumming down the fire." In the morning they break it up, rake out the ash at bottom, throw on a little fresh coal, and it burns till cooking time. The absence of all flame and of sparks precludes the danger which attends fires made of our more vivacious Northumberland coal; and it is so free from smoke that the laundress heats her irons by placing them on the top of the fire.

The making of "ball" is a regular business. The small dust of the anthracite coal called culm, which is found abundantly in the vicinity, is sold for this purpose. Blue clay, called "slime," is dug out of the Marsh at Holloway, to be mixed with the culm. A man then mingles the two together with the aid of water, much as mortar is made, only that the tenacity of the clay renders a good deal of kneading necessary. This is effected by treading with the feet, or sometimes by the aid of a rammer, like that used by paviours. Such a man is called a "ball-maker;" and his charge for making a load of ball is 1*s.* 6*d.* Such coal as emits a sulphureous smell, or "steam," as it is called, is unfit for use, and is scarcely saleable.

XXIII.

MANORBEER.

Welsh Castles—"The Paradise of Wales"—Roadside Cottages—Love of Flowers—Hyoscyamus—Hound's-tongue—Sea Spurge—Eryngo—Sea Bindweed—Picknicking—Cattle—The Beach—St. Gowan's Head—Stackpole Head—Cromlech—Fine View—Fissures—Mountain Stream—Sonnet—Manorbeer Castle—Towers—View from the Battlements—Church—Ancient Village—Orobanche—Beauty of the Scene.

July 19th.

Dr. Johnson said that "one of the old castles in Wales would contain all he had seen in Scotland." Allowance must, of course, be made for his anti-Caledonian prejudices, which were, as we know, somewhat virulent; but many of the Welsh fortresses are very magnificent. Llanstephan, on its rounded hill, that we passed on our way hither, is a monument of strength and massiveness; Kidwelly, that I see in the blue distance across the Bay of Caermarthen, is said to be remarkable for its huge vastness; Pembroke is a model of solid grandeur, set in a most commanding position; and I have just visited another fortress which may vie with any of them in all of these qualities, while, in its stern simplicity, it conveys an idea of even superior strength and impregnableness.

Rather a large party had determined to make a picnic to this grand antique; I can scarcely call it a

ruin, it is still so perfect. Some of us were strangers, eager to gratify curiosity; and others were kind friends of the vicinity, who found their pleasure in being *cicerones* to us, and in aiding our ignorance with their experience.

Manorbeer,—that ancient castle on the sea-shore, where Giraldus Cambrensis, the venerable historian, was born,—was our destination. We wished to see that place which was esteemed as the very "eye of Wales," bearing off the palm of beauty from every other scene in this land of the picturesque. "This county," says the admiring topographer, of his native place, "is well supplied with corn, sea-fish, and imported wines, and is tempered by a salubrious air. Demetia, with its seven cantreds, is the most beautiful, as well as the most powerful, district of Wales; Penbroch, the finest province of Demetia; and the place I have just described, the most delightful part of Penbroch. It is evident, therefore, that Maenorpyrr is the paradise of all Wales."

We halted on Holloway Bridge, the rendezvous of our party; and waited a little while for the arrival of our friends from Gumfreston. We stand up in the carriage, straining our eyes over the marsh to catch sight of their approach. At length we see a cavalcade of carriages and riders winding along the narrow country lane on the right; and presently we roll on, the rattle of stones beneath outdone by the rattle of merry tongues within.*

* Alas! while I prepare these notes for the press, I learn that one, whose loveliness and amiableness were like a sunbeam in our little party, is, within a short year, numbered with the dead! It was her bridal holiday.

Everything told of joy without. The birds, the insects, the flowers; the ripening corn in the fields; the purple hills; the breeze; the rapid interchange of sun and shadow as the clouds sailed by; the bright sea sparkling under the morning sun, as we opened its wide expanse between Giltar and Lidstep Head; the sleeping islands; the white line of breaking surf along the sweep of Lidstep Bay; the constant panoramic change of scene, as the various points of the landscape altered their relative positions—afforded us endless occasions of admiration, and sources of cumulative delight.

One great source of pleasure to me, in a rural walk or drive, is the sight of the roadside cottages; I do not mean the villas of the well-to-do, but the dwellings of the humble peasants and labourers. Very often, perhaps I might say generally, there is the manifestation of taste, and a love for the beautiful, which shows that the inmates, though poor, are not debased. The jasmine or the rose climbing about the low wall, festooning the door-porch, and spreading over the thatched roof, loaded with clustering blossoms; the geranium, or the fuchsia, or the cactus in the window; the garden before the door, or at the back of the house, kept in trim neatness, and filled with lovely, if common and old-fashioned flowers, often so luxuriantly beautiful as to put to shame the efforts of the squire's professional gardener,—these features make our English and Welsh cottages objects on which the eye of the chance passenger loves to rest, presenting a striking contrast to the unmitigated squalor that characterizes the cabins of the poorer

Irish. The love of flowers, and the desire to have them about us, is preeminently English, peculiar to no class or grade of society, but pervading all from the noble to the hind; and I would hail it wherever I see it. I do not mean to say that vice and misery may not be found lurking under a cottage bright with China roses; but surely, where one sees flowers trained and cherished, and evidently loved, there one may hope that gentleness and peace have found an abode. Such dwellings are very common hereabout, as I have found them in Devonshire also; and they contribute greatly to the charm of the country.

Our journey was not long to-day: three or four miles of pleasant road, a good deal of which was under the arching wayside-trees, brought us suddenly within close proximity of the great solid pile, the first sight of which so close before us was particularly grand. The treacherous clouds were gathering up, and already looked ominous; we therefore determined to make use of the open air while we could, deferring the exploration of the Castle until we had explored the shore.

Scarcely are we out of the shadow of the castle walls than we are on the sands of the beach. There was growing the narcotic Hyoscyamus, with its hairy thick stems viscid to the touch, and flaccid embracing leaves. I admired the handsome cup-like flowers nestling together in clusters surrounded by the leaves, the veining of the petals, and the purple stamens standing up out of the deep purple-black depth of the corolla; though the rank and almost fetid odour of the whole plant repelled a very close acquaint-

ance. There, too, was another ill-smelling flower,—the Hound's-tongue, with chocolate-coloured blossoms, curiously arched over by projecting scales.

The Sea-spurge, a somewhat uncommon plant, was here abundant, growing out of the loose drifted sand, with stalks springing several together from each root, about a foot high; greyish leaves set apparently, not really, in whorls, becoming tender green above, and giving rise to many umbels of the curious flowers with yellow nectaries. The formidable Eryngo, the "*nemo me impune lacessit*" of the shore, stood there also, like a small holly-plant, only that the beautifully-veined leaves are glaucous, and they bear prickly artichoke-like heads. One might have fancied this plant the defending Knight, armed at all points, of the lovely Bindweed, the Lady Soldanella, who lay at his feet, entwining them in her embrace. Certainly she, in her rosy beauty, reclining languidly along on the yellow sands, was no unworthy emblem of the fair; and you may, if you please, write "A Romaunce of the Loves of Syrre Eryngo and the Ladye Soldanella;" and you may make Manorbeer her castle.

Meanwhile I must saunter down to the party, for I see they have clustered under the shadow of yonder headland, where, by the gleams of snowy linen, I perceive they are "on hospitable thoughts intent." Yes, I catch the glitter of the forks and spoons, and the—hark! what was that? Surely it was a pistol-shot! No, 'twas but the pop of a champagne cork. Well, I must be among them.

How peacefully the kine—literally, *black* cattle—

are lying on the sand at the very margin of the tide! I suppose it is a characteristic habit with them; for I saw them congregated in just the same manner at the water's edge, at Lidstep, the other day. How grandly the sea rolls in, and makes arching galleries, breaking instantly into a wilderness of foam, as white as snow! And those noble headlands projecting on each side of the beautiful bay—great terraced cliffs of "old red;" and yonder, in front, St. Gowan's Head stretches across the horizon, like a blue wall; and nearer to us Stackpole Head, more magnificent still —a bluff more than perpendicular, actually overhanging, like the awful head of that statue of Jupiter which was the masterwork of Phidias.

We have done justice to the viands, and have made herculean efforts to drink dry the little rivulet of sparkling water that divides the sands, and winds along the foot of the southern cliff, where the blue racemes of Brooklime are dipping and laughing in the sparkles,—and now we essay to scramble up the steep to hear our worthy friend the Rector lecture on Cromlechs, in presence of an example.

Narrow and difficult is the path, and not devoid of danger; for the dashing sea is beneath us, as we wind slowly along the edge of the slope, through clumps of furze, and deceitful landsprings, and over the rocks slippery with dark green *Confervæ* and *Marchantiæ*. Presently we come upon the Cromlech—one of those rude but lasting memorials of the ancient Druidical religion, which exist so numerously in the Principality. It stands on the west slope of the

headland, a large flat unhewn slab of red sandstone set on three uprights, forming three sides of a square, or nearly; the hill itself being the support of the fourth side. The slab measures about sixteen feet by twelve, and varies in thickness from two feet to an obtuse edge in front.

Looking back from this primeval altar, we had a noble view of the Castle (which is perhaps seen to most advantage from this spot) and of the surrounding valleys. The vale, which passes up to the north of the Castle, and is lost to view by winding between hills wooded from the summit to the base, is specially picturesque.

We did not, however, yet return, as there were other "lions" to be seen. A little farther round the verge of the promontory, there is a series of fissures in the sandstone rock, which are among the most remarkable phenomena I ever saw. The first occurs about a hundred yards beyond the Cromlech; we look down into a cleft a yard in width, and, as well as we could estimate, a hundred feet in depth, the sides perfectly straight, plane, and parallel throughout, and quite perpendicular; the sea was washing up the narrow alley, all white with foam.

The second fissure, a little farther on, is less deep, and perhaps six feet wide; so that the effect is less striking, though it possesses exactly the same character.

The third is perhaps the most curious of all. By this time the tip of the promontory has been rounded, and the land trends to the eastward. As the strata,

however, maintain the same direction throughout, so of course do the fissures; and hence this one is parallel with the line of coast, instead of being at right angles with it, as the others are. It is a similar straight-sided, narrow chasm, very dark, at least to us, looking into it from above, about five feet wide, seventy yards long (as nearly as I could judge by pacing it), and perhaps a hundred and fifty feet deep. The bottom at the end most remote from the sea was white; but whether this indicated sand or froth blown in and accumulated, we could not determine. At the western end we could see a narrow crevice, and the bright sea through it, which doubtless finds its way into the cavern. At the summit, where the fissure terminates, there is a layer of crumbling earth between the parallel strata of the compact red sandstone; and it is doubtless by the washing away of this—the débris of a vein of softer rock—that the cleft has been made, and is still extending. Altogether, these fissures are highly curious, and worthy of the investigation of the geologist.

We returned over the heathery hill, crossing a little streamlet, which now expanded into a tiny basin, in which the white blossoms of the Water Pimpernel were bathed, now falling in a miniature cascade or rapid down the broken rocks, and now diminished to a glittering thread, almost invisible beneath the herbage. I do not know that I should have noticed it, had not one of our party taken occasion from it to repeat to us that beautiful sonnet of Passerini's, the latter part of which might almost have been composed by the side of this tiny rill.

"The more divinely beautiful thou art,
Lady! of love's inconstancy beware.
Watch o'er thy charms, and, with an angel's care,
O guard thy maiden purity of heart.
At every whisper of temptation start:
The lightest breathings of unhallow'd air
Love's tender trembling lustre will impair,
Till all the light of innocence depart.
So from the summit of some Alpine hill,
As the coy fountain sparkles into day,
And sunbeams bathe and brighten in its rill,—
If here a leaf, and there a flower, in play,
Bending to sip, the little channel fill,
It ebbs, and languishes, and dies away."

But now it was time to look at the Castle; and so we toiled back over the heavy sands, winding beneath the lofty wall, where doubtless many a band of spearmen have marched, till we came to the north-east side. Here a gateway through a massive square tower, with two portcullises, admits us into the great inner court, covered with its green undulating turf, all undisturbed, except when curious visitors like ourselves pass over the rank grass. On our left the side of the court is made up of half-ruined gables, walls, and tall conical chimneys of dwelling-houses; while the eastern angle is occupied by a massive round tower, doubtless the Keep.

We cross the court, and at the south end pass up some stone steps, and enter the banqueting-hall—a fine room, with gothic arched roof in good preservation. The roof and walls have been lime-washed, and the plaster, though mildewed in patches, is entire; the apartment is floored with square tiles, and lighted with small square windows.

Out of this we pass into another vaulted room on the west, from a window of which a fine view to seaward is obtained. Thence a narrow, vaulted, well-windowed gallery leads to a dark vault or dungeon, or perhaps a sally-port.

A winding staircase of stone at the corner of the banqueting-room leads up to the battlements. Here a glorious prospect rewarded the climbers; fine on all sides, but especially to the north, where that beautiful valley that I before spoke of winds up, wooded on both sides. In front the mouth of the valley expands into a plain, which reaches to the foot of the Castle-hill. Here there was once a lake, formed by damming up the stream which still flows along the foot of the farther hill. A dovecote, like a small round tower with a dome of stone draped with ivy, is still standing, as it stood in Giraldus' day, close to the embankment which ran across; the embankment itself was removed only last year. The grassy hill-side yonder was anciently clothed with vineyards; and on the sloping side of that sheltered vale were the woods which the partial historian celebrates as formed of "such very tall hazel-trees."

We turn towards the south-east, and look across another valley scarcely less interesting. The hollow, which was anciently occupied by "deep fish-ponds," is now varied with grassy mounds, worn into terraces by the feet of the sheep, which delight to follow each other's footsteps, and to perpetuate a track they have once chosen. On the opposite hill the Church rears its old military tower, of the square Flemish type, grey with age and weather. I noticed this pecu-

liarity in it, that instead of "battering out"—that is, being rather larger at the base than at the summit—it has rather a top-heavy appearance, which is due to the corbels of the parapet. My friends described the interior of the Church as being highly curious and unusual, but we had not time to examine it. Around it stand old ruined houses, with tall Flemish chimneys, once the dwellings of the retainers and vassals, irregularly scattered.

I need not describe in detail the various towers and apartments of this extensive baronial mansion, which occupied the whole afternoon to go over. The examination left a vivid impression of the almost regal state in which the establishments of the middle ages were maintained, and of the strange mixture of the comforts and luxuries of peace with the grim and bristling array of war, which was indispensable in an iron age,

"——— when law secured not life."

And so we reluctantly bade farewell to the mansion where the old ecclesiastic, doomed to constant disappointment, soothed his chagrin by the pursuit of literature with an industry more characteristic of our "fast" age, than of his own. We passed in silence out of the gate, only giving one more interjection of delight at the lovely peep of scenery which is caught through an arch in the stables that stand on the north-west; and wending along the scarped way, battlemented on one side, to a wicket in the outer wall, found ourselves once more in the little ancient village, coeval with the Castle, doubtless, but still

inhabited by the descendents of the old inhabitants; the humble peasantry maintaining their perpetuity, when the race of nobles who once ruled alike the soil and them, has long passed away. I carried in my hand, almost unconsciously, one little memorial of the mouldering pile, which I had plucked from the midst of the ivy and long grass that grew on the battlements of the watch-tower above the gate: it was the *Orobanche*, whose massive leafless stem, and dried-looking brown flowers, seemed in keeping with these relics of a former age.

I scarcely wonder at the exalted terms in which Giraldus has praised his residence. It is still a place of great beauty. The magnificence of the sea-view, especially when the giant waves of autumn break upon the beach, chased by the storms of the whole Atlantic—for the sea-bird, pursuing a straight line from this little bay, would find no rest for its foot till it reached the Southern Pole—the grandeur of the red cliffs that hem it in on either side, and of the beetling promontories that recede in the distance, can scarcely be surpassed; and I have repeatedly expressed my admiration of the quiet loveliness of the landscape, as seen from various points of view. Perhaps none surpasses one from the bank of the little brook just below the bridge; where the Castle, seated on the verdant hill like a royal crown, stands forth in full and massive majesty; particularly when, as I beheld it, the bright warm golden light of a declining sun irradiates the tall towers and battlemented walls. The broad north-west and south-west sides are both partly concealed by enormous fan-shaped sheets of

dark-green glossy ivy, the growth of centuries; and the battlements are fringed and festooned with profuse herbage, tossed by the breeze in wild grace and beauty. Surely, when that noble pile was reflected in the placid lake below, and the hills around were covered with vines, and gardens, and richly-cultivated fields, and the antlered red deer were gazing out of yonder wood, and the snowy swans were "mantling proudly" on the water, and a thousand accompaniments of life and ease and opulence were scattered everywhere about—this sequestered bay must have been little short of a "paradise."

XXIV.

THE LIFE-BOAT.

Life-boat and Crew—Gambols—Capsizing the Boat—Her Construction—Value of the Life-boat.

July 21st.

LOOKING out just now, I saw a great crowd on the quay, and groups of people eagerly running through the street to join them. I seized my hat, and went down too, a boatman informing me on the way that they were going to have some life-boat practice. When I got to the quay, I saw a great awkward-looking craft, painted light blue, very much curved in her shear, and rising to a high peak at each end. Seven or eight young fellows were putting on jackets made of parallel strips of cork bound together. Presently three or four of them jump overboard, and, being of course sufficiently buoyant in their cork armour, play rude frolics in the water, much as you may fancy the two Hippopotamuses at Regent's Park to do, should they turn merry-andrews. Meanwhile the others prepare to turn the life-boat over.

For this purpose they brought a lighter alongside her; and, having first girded her with two bands of rope, made fast a chain to these, and hooked it on to the quay-crane. "Now then! all right?" "Wind

away!" The fellows who suffer the experiment,—the patients under the operation,—have stowed themselves away in the bottom of the boat, beneath the thwarts, which they grasp with nervous energy in their arms. The windlass turns and turns, creaking musically; the chain goes up and up, dragging one side of the boat with it. Presently over she heels, the lads grasping the thwarts with a more affectionate embrace, and looking very blue, as she turns her summersault. The crowd give a loud hurrah, as up she comes, righting herself in a moment; while the men, like half-drowned kittens, splash and splutter, dash away the water from their hairy faces, and grin at the cheering spectators ashore.

I find it is a new boat, as yet untried, made on a new principle by Beecher of North Yarmouth. The principle was described to me as consisting of air-boxes in her sides, so that it is impossible she should ever fill, the water not being able to rise in her beyond a certain bearing. Her curved form prevents her lying capsized, as was shown in the experiment, while it gives great facilities in turning, a single stroke of the steering oars moving the boat as on a centre. What degree of superiority attaches to this boat over Greathead's, I could not ascertain; all the benefits arising from her form must, I suppose, belong equally to both; and whether the superior lightness of the air-cells over the lining of cork in the old form is not accompanied by a greater tendency to rupture, I cannot say. The Coast-guard men, however, appeared to think well of her performance.

I thought the exhibition one of the most interesting things I had seen here. The direction of ingenuity and mechanical art to the saving of human life strongly appeals to human sympathies,—"*nihil humanum a me alienum puto;*" and the claim that the life-boat, as an invention, has on them is well shown in the simple fact, that in the first fifteen years after the construction of Greathead's boat, no fewer than three hundred human lives had been saved from vessels wrecked in the vicinity of the Tyne alone.

XXV.

PEDICELLARIÆ.

Conflicting Opinions of Naturalists—Dr. Sharpey's Description—Professor Forbes's Observations—Mr. Sars's Opinions—Forbes's Strictures on these—Pedicellariæ of Starfish—Calcareous Skeleton—Those of Sea-Urchin—Three Forms—P. triphylla—P. tridens—The Blades—Teeth—Cavities—Surface Glands—Comparison with a Spine—Cilia—On Pedicellariæ—On Spines—On Suckers—Professor Agassiz on Locomotion in Echini—Skeleton of P. tridens—Its Beauty—P. globifera—P. stereophylla—Observations of M. Valentin—Supplementary Suggestions of M. Agassiz—Pedicellaria on a Mollusk.

July 24th.

Among the Echinodermata, the Urchins and some of the Starfishes are always found to be studded with minute bodies, about which the opinions of zoologists were for a long time divided. Müller, the eminent Danish naturalist, considered them as distinct animals, parasitic on the Urchins, and assigned to them distinct generic and specific names, naming the (supposed) genus *Pedicellaria*. Others judged them to be organic appendages of the Echinoderms, like the suckers and spines, but could not determine their function, nor even plausibly conjecture it. This opinion is now generally received; but the name of *Pedicellariæ* is still employed to designate them, though it is not used in a generic sense.

I have lately made some observations on these bodies, which have perfectly satisfied me of their being essential organs of the Echinoderm. Before I detail these, however, I will quote what Professor Edward Forbes says of them, as showing how the question stood at the time when he wrote his excellent "History of British Starfishes." A previous observer, Dr. Sharpey, had thus described the *Pedicellariæ*, in his account of the anatomy of *Uraster rubens*:—"They cover the surface generally, and form dense groups round the spines. Each consists of a soft stem, bearing on its summit, or, when branched, at the point of each branch, a sort of forceps of calcareous matter, not unlike a Crab's claw, except that the two blades are equal and similar. When the point of a fine needle is introduced between the blades, which are for the most part open in a fresh and vigorous specimen, they instantly close and grasp it with considerable force. The particular use of these prehensile organs is not apparent; their stem, it may be remarked, is quite impervious."

Professor Forbes, citing these observations, thus proceeds to record his own:—"I have examined them very carefully in the same species. Those on the body and upper spines differ in shape from those on the spines immediately bordering the avenues. The former are much shorter and blunter in the blades than the latter. The calcareous forceps, of which their heads consist, are imbedded in an integument of soft granular tissue, which envelopes the forceps when closed; and this apparatus is mounted on a bulging body of a similar substance, which crowns

the round, flexible, and contractile peduncle, sometimes simple, sometimes branched, each branch having a similar termination. I could detect *no evidence of vibratile cilia* on their stalks; but there appeared to be ciliary motions within the blades. When the Starfish is alive, the *Pedicellariæ* are continually in motion, opening and shutting their blades with great activity; but when cut off, they seem to lose that power. If they be not distinct animals, as Müller fancied, for what purpose can they serve in the economy of the Starfish? If they be parasites, to what class or order do they belong?—what is their nature? what their food? Truly, these are puzzling questions. These organs or creatures have now been known for many years—have been examined and admired by many naturalists and anatomists—have been carefully studied and accurately delineated, and yet we know not what they are." *

Mr. Sars, a clergyman of Norway, who is deservedly eminent for his researches among the lower forms of marine life, gives the following reasons for considering these very curious bodies to be organs of the Echinoderm. His remarks apply directly to those of the *Echinidæ*.

"If we consider the construction of the *Pedicellariæ*, and their manner of life as a whole, we can scarcely believe them to be anything but organs of the Sea-Urchin. The following reasons seem to prove the accuracy of this opinion:—

"1st. In all Sea-Urchins, without exception, are found *Pedicellariæ*, and under the same circumstances;

* Brit. Starfishes, p. 98.

which would certainly not always be the case if they were parasitical animals. Just as *Lerneæ* are not always found in all fishes, &c.

"2d. The hard calcareous teeth or plates, and the internal stem, also calcareous, and often filling up alone the sheath, which are found in all *Pedicellariæ*, bear a greater resemblance to an *Echinus*-spine than to any animal of the Polype kind. There is neither opening, nor mouth, filaments, &c.

"3d. The *Pedicellariæ* are firmly fixed in the skin which envelopes the whole Sea-Urchin, upon a very small projecting knob of the shell, to which knob they are very strongly attached, but yet moveable, like the prickles of the Sea-Urchin; the under-surface of the stem of a *Pedicellaria* being somewhat hollowed and articulated with the knob. When a *Pedicellaria* is torn out, it is observed that the sheath or skin connecting the stem is torn at the lower end; which, doubtless, is a consequence of its connexion with the skin, with which the shell of the Sea-Urchin is covered, and which, when the *Pedicellaria* is torn out, must be rent.

"4th. When the skin of the Sea-Urchin, or a single *Pedicellaria*, is irritated—for example, with a pin—the surrounding *Pedicellariæ*, which stand in a wide circle, invariably bend themselves quickly towards the irritated part. This phenomenon, which I have often observed, shows clearly an organic connexion between the *Pedicellariæ* and the skin of the shell of the Sea-Urchin. The same thing precisely is observed with the spines."

On the purpose of these organs Mr. Sars remarks,

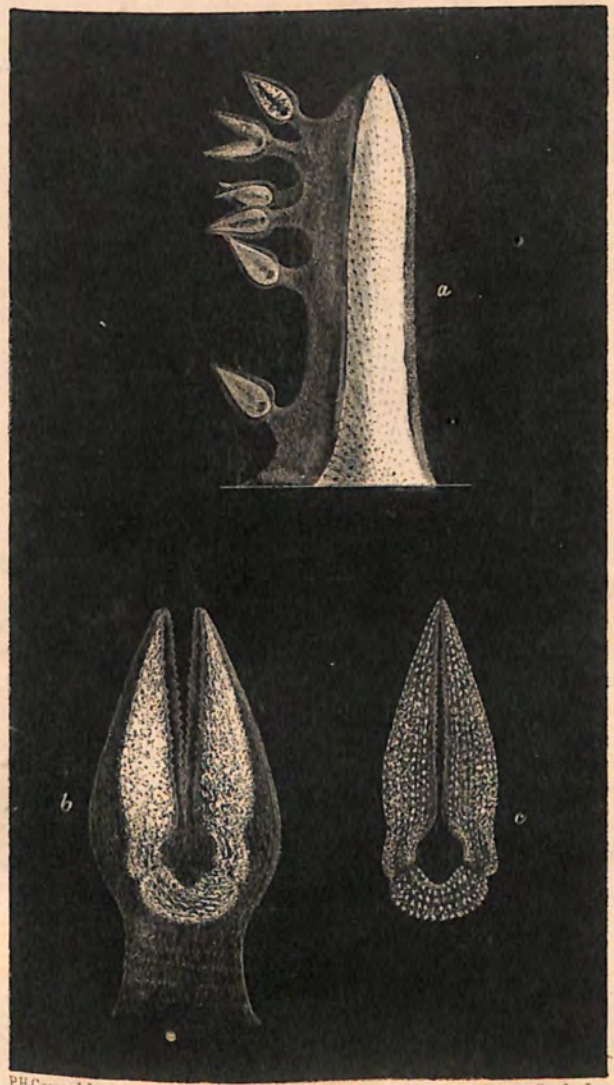
"Perhaps Nature, who has so abundantly provided the Sea-Urchin with such an astonishing number of feet and prickles, has also given the *Pedicellariæ* as a sort of antennæ, partly to seize the small animals which serve for its sustenance, partly to lay hold of whatever might approach the sensitive skin which covers the surface of the shell, and thus, in conjunction with the prickles, protect it from injury." He says that some which he had cut off moved six hours afterwards with considerable liveliness.

Professor Forbes, to whom I am indebted for these quotations, differs from Mr. Sars as to the results of some of the experiments recorded; and thus balances his own doubts on the subject.

"The fleshy substance of these bodies is exactly that of many animals of acritous structure; and they are so scattered over the body of the Urchin, without reference to form or figure, that it is almost impossible to assign them, or the various kinds of them, special offices in the animal's economy. Each seems independent of the others, and of the Sea-Urchin, which is not the case with the spines. As to their resemblance to an *Echinus*-spine, I can see but little. I agree with Mr. Sars in believing Schweigger to have been mistaken when he stated *Pedicellariæ* to exist on certain testaceous Mollusca;* but *can by no means consider the question of their nature to be settled*, and find myself quite undecided as to whether they are organs of ECHINODERMATA, or parasitic creatures, though inclined to the former opinion."†

* See Mr. A. Adams's Observation, page 250, *post*.

† Brit. Starfishes, p. 159.



P.H.Gosse del.et lith. Vincent Brooks Imp.

Pedicellariæ of Star-fish.

I proceed now to give you the results of my own observations on these curious objects, and shall commence with those which are found on the Starfishes.

In *Uraster rubens* the *Pedicellariæ*, or the bodies which Professor Forbes calls *Spinules*, and which represent the *Pedicellariæ* of the *Echinidæ*, &c., are but of one form. They are scattered densely over the body and rays, clustered round the bases of the spines, and especially set in dense groups or tufts near the extremities of those spines which border the avenues. I do not see any important difference in shape between those of the superior surface and those of the avenues; though specimens in both situations differ considerably *inter se*, in their length and general development. They are thick and clumsy, compared with those of the *Echini*; flattened, and composed of but two blades. They can scarcely be called branched, but rather resemble several trunks of a tree springing from a common root. It is not unusual for an avenue-spine to have a tuft of six or eight spinules thus clustered, springing from its interior side near its tip, and a solitary one near its base. (See Plate XI. fig. *a*.)

When examined in a recent condition with a power of 220 diameters, the base of the stem of each *Pedicellaria* is seen evidently to be continuous with the common integument that invests the spine, and organically united to it, there being not the slightest trace of suture, or perceptible difference of structure. I cut off with a razor a thin transverse slice of a living ray, and immediately laid it, covered with sea-water, on the stage of the microscope. The *Pedicellariæ* were quite motionless and evidently dead, like the suckers with

which they were associated; a result which would not have instantly occurred, had the former been parasitic animals.

The form of these bodies resembles that which the flame of a candle assumes, with its wick, supposing the latter, which represents the neck or footstalk, to be thicker than usual. This is the form when viewed perpendicularly to the plane of the opening blades; for, in a direction at right angles to this, the width is much less. The pointed pyramidal body (representing the flame) is cleft to a considerable distance downward; and the two portions open and close on each other, like the blades of scissors. The points occasionally cross each other; but more commonly their edges, which are minutely, but irregularly, jagged, come into contact. (See fig. *b*.)

The whole body consists of a colourless, transparent, gelatinous flesh, enclosing a hard support, which runs down each blade from its tip to its base, and unites with its fellow beneath the bifurcation, but does not descend into the footstalk; the latter appears to be solid, with no trace of stomach, tube, or other cavity. No sign of cilia did I detect either within or without the blades, though from analogy I suspect their presence.

On dissolving away the fleshy investiture by means of a solution of potash, I obtained the calcareous supports free, and was enabled to see their exquisite structure. (See fig. *c*.) They bear the closest resemblance to a pair of shears used for shearing sheep; each blade being slightly curved to the point, and terminating at the base in a knob, which is jointed to a curved piece uniting the two. The only difference between this

and the shearer's implement, is that the blades of the latter are worked by the elasticity of the metal; those of the *Pedicellariæ* are hinged. Their texture is most beautifully delicate; formed of calcareous substance as transparent as glass, and reflecting the light like that material, hard but very brittle, corrugated on their surface by close-set hollows, which run in lines sub-parallel to the margins, and excavated throughout their interior by minute round or oval unconnected cavities. This structure is identical with that of the spines of the Starfish themselves; for these, when deprived of their gelatinous investiture, in like manner, display similar cavities, and a similarly corrugated surface; the corrugations, however, running upward from the base in slightly divergent rather than parallel lines. The cutting edges of the blades are thin and knife-like, without any cavities or corrugations, but notched or jagged minutely, as already stated.

In the Sea-Urchins (*Echinus*) we find *Pedicellariæ* in great numbers, and of several very distinct forms. Of these Müller described three, which he named *P. triphylla*, *P. tridens*, and *P. globifera*. They all agree in these particulars: that each has a long, slender, cylindrical, fleshy stem, through the centre of which runs an axis or rod of calcareous substance; that the base of the stem rests on the skin of the Urchin; that on the summit is placed a head consisting of three pieces, which are capable of being widely opened, and of being closed together, at least at their tips; that the edges of these pieces which come into mutual contact are furnished with teeth, which lock into each other; that the head-pieces (like the stem)

consist of calcareous centres, clothed with flesh; that, besides the opening and shutting of the head, the stem can be swayed from side to side; and that all these movements are spontaneous, and apparently voluntary. It appears that the head-pieces close on any object presented to them, such as the point of a needle, and hold with considerable force and tenacity, so that the *Pedicellariæ* may be drawn out of the water without relaxing its grasp.

My observations have been made on *Echinus miliaris* and *E. sphæra*, the former called by Forbes the Purple-tipped Egg-Urchin, the latter the Common Egg-Urchin; though both here, and on the Dorset coast, the former is much more common than the latter. It is much smaller, and is frequently found within tide-marks, which is not the habit of the latter, at least in my experience. *E. sphæra* is by far the finer species.

Pedicellaria triphylla of *Echinus miliaris* consists of three broad and thick sub-triangular pieces jointed into a head, set on a *thickish* stem of transparent gelatinous fibrous substance, in which a slender core of calcareous matter runs, that looks fibrous and blue. The three moveable pieces or blades are convex externally, concave internally, thin in substance, furnished along their opposing or concave sides with two longitudinal ridges or keels, each of which is cut into the most beautifully fine teeth, so that the edge of each ridge looks like a shark's tooth: the edges of the pieces are also similarly toothed. These shut precisely into each other.

In *E. sphæra* the head-blades of this kind have

one stout central ridge, which is rounded and not toothed. It forms the front of a great interior cavity, into which there are two orifices on each side of the column.

The moveable pieces enclose a skeleton of calcareous substance, glassy, colourless, and brittle, in which are excavated a multitude of oval cavities which form irregular rows; a central line runs down each, that is solid and free from cavities. This calcareous skeleton is encased in a gelatinous flesh, similar to, and continuous with, that of the stalk.

This is the smallest kind, the head being about $\frac{1}{36}$th of an inch in height.

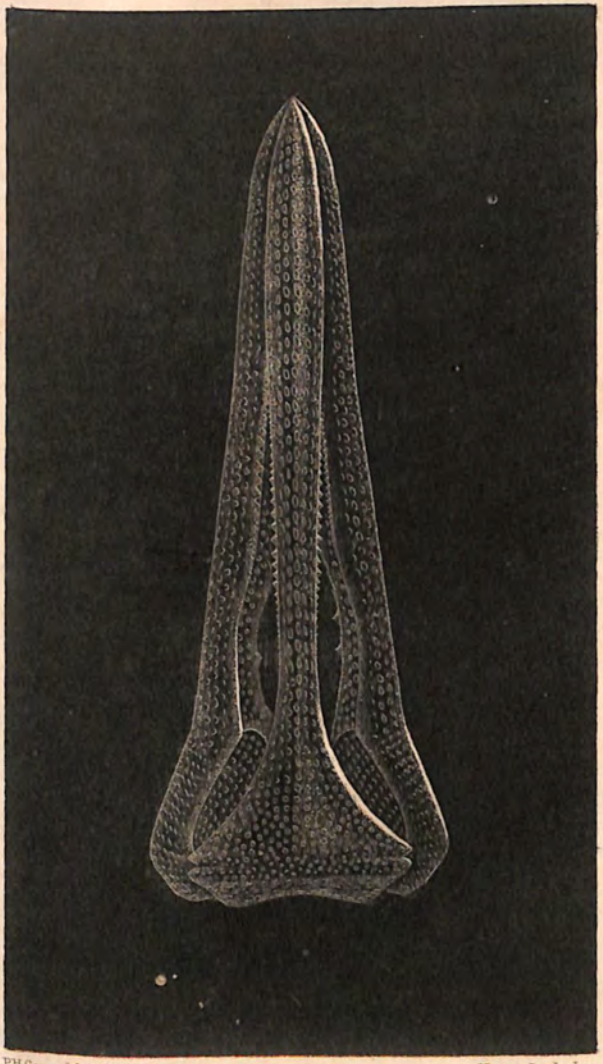
Considerable modifications are found to exist in the details of each form, in the relative proportions which the parts bear to each other, and so forth; so that two forms, which in their extreme conditions widely differ, mutually approach, and appear to run into each other. This is the case with the present and the succeeding form.

P. tridens is much larger than either of the other forms; the moveable head being about $\frac{1}{20}$th of an inch in length, and the whole organ about $\frac{1}{8}$th of an inch. This may be considered as *P. triphylla*, with the blades greatly drawn out in length, and at the same time rendered quite slender, so that they may be called pins; they meet only at the points, where they often cross, the interspaces of the basal parts being open. The inner edges of these are notched with teeth as in *P. triphylla*, of which those near the tips are larger, and cut into subordinate teeth of exquisite minuteness.

The oval or square granules, which are thickly placed throughout the calcareous substance of the blades, are certainly cavities in it; for when the pins, which are very brittle, are broken, the edge of the fracture is not even, but jagged with holes exactly corresponding with the marks in question.

The investing membrane of the bulbous head and the neck in each kind is studded with minute round specks (glands?), of a reddish colour; they are set without regularity, but are rather more profuse around the lower part of the head. Now, on examining a locomotive sucker from the same *Echinus*, I find its surface studded with precisely similar glands; a strong argument, to my mind, that both are alike essential organs of the same entity.

Professor Forbes remarks on an observation of Sars, —"As to their resemblance to an *Echinus*-spine, I can see but little." It is true, there is little resemblance in form or appearance; but in structure, which is much more germane to the question, the similarity is most close. On examining a spine by transmitted light, I saw that its calcareous centre was full of oval specks; and, on breaking it to pieces, I found that it was indeed a brittle, bluish, transparent substance, exactly resembling that of the *Pedicellaria*, filled with oval cavities of the same size, and arranged in the very same manner, and breaking with a precisely similar fracture. Its exterior was clothed with a similar gelatinous epidermis, thin, indeed, and tightly stretched over it, so as to fit the grooved surface accurately, but studded, like the surface of the *Pedicellaria*, with the red glandular specks just described.



P.H. Gosse del. et lith. Vincent Brooks Imp.

Skeleton of Pedicellaria

In order to determine the order of arrangement of these bodies, I carefully picked off with a forceps the spines one by one, from one ambulacrum and the adjoining inter-ambulacrum. But I found that, though the *Pedicellariæ* are in general set pretty evenly around the spine-knobs, it is without regularity of arrangement; and the three kinds are indiscriminately mingled. Yet the *globifera* preponderates around the anal region, and the *tridens* is mostly found around the circumference or equatorial regions. But this irregularity is no argument against their being organs, since the spines themselves, especially the secondary ones, follow no definite arrangement in detail.

Their surface is set with very fine cilia, whose vibrations agree accurately, both in direction and extent, with those of the spines.

Professor Forbes avers * that he has not been able to see the cilia on the *spines* of the Sea-Urchins, and doubts their existence for analogical reasons. But in *E. miliaris* I detect them very plainly, with a power of 220 diameters, and that not only by the currents which they produce; for around the basal portion, especially (though not exclusively) of the secondary spines, the cilia themselves are seen with perfect distinctness, apparently very numerous and short, with rapid movements. It is true we may examine several spines, and not detect any ciliary action, particularly if they have been many minutes separated, or if they have been injured, bruised, or broken in detaching them; but if pulled from the basal knob, and at once

* Op. cit.; p. 153.

put into the aquatic box, they will generally be seen plainly enough, but will cease to play after a few minutes. In one or two cases I have been able to trace the action to the very tip; but generally it is visible in the ratio of nearness to the base.

The ciliary currents are not longitudinal, but transverse, and somewhat peculiar. The floating atoms are drawn in at right angles to the length of the spine, and presently hurled away in the same plane; forming a circle, whose plane is perpendicular to the axis of the spine.

The *suckers* also are densely covered with fine vibratile cilia. These are most surely organs of locomotion. When Professor Agassiz says* this notion is absurd, one is almost tempted to think that he never saw an *Echinus* in progression. I have been accustomed to take up my specimens, dragging them from their moorings (even at the risk of tearing asunder these delicate organs, as often happened), when I wished to institute some special examination, and hold them against the glass side of the Aquarium for a few seconds, when invariably the suckers were one by one appressed to the glass, and presently adhered, so that I could fearlessly let it go. Immediately more and more were put forth, and stretched to their utmost extent, firmly mooring the animal at all points. Here it would occasionally rest motionless, except for the continual waving to and fro of the free suckers and the spines; but now and then it would set out on a march, and advance deliberately, but still tolerably fast, all round the glass sides.

* "Prodromus;" cited in Br. Starf. p. 143.

Certainly Professor Agassiz would not say that the spine-tips alone could enable an *Echinus* to march securely along a perpendicular plate of glass. Besides, it needs but a glance to see that it is the suckers that really carry the body along.

The ciliation of the integument in the *Pedicellariæ* has led me to speak of the same armature in the spines and suckers, and thence I have wandered to the use of the latter organs. Pardon the digression, and return with me to the proper subject of these notes.

Two specimens of *P. tridens*, treated with potash, enabled me to see the calcareous support better. The head-blades expand at the base into three-sided prisms or pyramids, each of the two interior sides of which is indented with a large cavity, leaving a projecting dividing ridge, armed with teeth somewhat remote from each other. The one exterior angle is toothed in a corresponding manner, but the opposite angle appears plain. The angle of one blade-base fits into the cavity of its neighbour; and, so far as I have observed, when the two edges thus overlap, it is the toothed one that is on the outside. Looking from the circumference towards the centre of the head, it is the left angle that is toothed and external, the right being plain and sheathed. This observation applies to *E. miliaris;* for, in the corresponding organs of *E. sphæra*, both sides of the trigonal base appear untoothed except close to the bottom, where a deep notch indents each margin. (See Plate XII.)

Viewed from beneath, the head assumes an outline which is rondo-triangular; but yet such that each side of the triangle has a very obtuse projecting angle in

the middle, where the blade-bases meet each other. They fit accurately; and each has a deep oblong cavity in its bottom, which does not, I conceive, communicate with the interior.

When one of these heads, divested of its fleshy parts by immersion in caustic potash, and then well cleansed by soaking in clean water, is placed under a low power of the microscope—100 diameters, for example,—with a dark ground, and the light of the lamp cast strongly upon it by means of the Lieberkuhn, or the side-condenser, it forms an object of most exquisite beauty. The material has all the transparency and sparkling brilliance of flint-glass; while the elegantly-shaped pins, the perfect symmetry of the prismatic bases, the arch which is lightly thrown across their cavity, the minute teeth of the tips locking accurately into each other, and the oval cavities in the whole structure set in regular rows, and reflecting the light from thousands of points, constitute a spectacle which cannot fail to elicit the admiration of the examiner; and which is but poorly suggested (I will not say expressed) by my attempts to represent it. Surely it ought also to evoke adoring praise to the great and glorious God, of whose handiwork it is but one specimen out of thousands, that are scattered with lavish profusion over the surface of every Sea-Urchin that creeps about the rocky caverns of the deep.

P. globifera (see Plate XIII. fig. *a*) is formed on the same model as *P. triphylla*, but is more globose, and each piece appears to have a deep cleft at the point, which does not extend to the interior side; where a thick ridge

runs down from the point to the base. At the summit of this ridge, in each of the three divisions, there is set a strong acute spine, directed horizontally inwards, so that the three cross each other when the blades close, which they do energetically,—a formidable apparatus of prehension! The stem is much more slender than in *P. triphylla;* the height of the head of one of average size was $\frac{1}{43}$d of an inch. It is peculiar also in being slender throughout, and in having the knobbed calcareous stalk extending up to the head, which appears to work on it. In each of the other sorts the stalk extends only through a part of the distance, above which the investing neck becomes wider and empty.

The internal structure is not quite the same as in the others. The main portion of the head is composed of gelatinous flesh; the calcareous support being reduced to that ridge which runs up the interior side of each blade. It is somewhat bottle-shaped, with a bulbous base, and a long slender neck, with two edges on the inner face, which are armed with horizontal hooked spines, some of which are double, and the whole terminates in a sort of ring, formed by the last pair of spines, which unite into the acute horizontal point above-mentioned. The skeleton is filled with oval cavities, like that of the others. (See Plate XIII. fig. *b*.)

There is yet a fourth kind of *Pedicellaria*, quite distinct from either of the others, which I shall call *P. stereophylla*. (See Plate XIII. fig. *c*.) It is very minute, the head being only $\frac{1}{200}$th of an inch in height. The head is a prolate solid spheroid, cut into three segments, exactly as if an orange were divided by three perpendi-

cular incisions meeting at the centre. Thus the blades meet accurately in every part when closed, but expand to a horizontal condition. These are almost entirely calcareous, being invested but thinly with the gelatinous membrane. They are filled with the usual oval cavities, set in sub-parallel arched series.

The head is set on a hollow gelatinous neck nearly as wide as itself, and thrown into numerous annular wrinkles; its walls are comparatively thin, disclosing a wide cavity, apparently quite empty, as the blue calcareous stem extends only half-way from the base to the head. At this point the neck contracts rather abruptly, and continues to the base, but just wide enough to invest the stem.

This sort is confined, so far as I have seen, to the ovarian plates and their vicinity, where they are numerous.

From all the above observations, I cannot for a moment doubt that the *Pedicellariæ* are as truly and essentially organic parts of the Starfish and Sea-Urchin, as are the spines, or the locomotive suckers.

Since the above was written I have had an opportunity of consulting the excellent Memoir of M. Valentin on the Anatomy of the genus *Echinus*.* He enters elaborately into the structure and nature of the *Pedicellariæ*, to the three kinds of which, as enumerated by Müller, he gives French names, which do not appear to me to be at all preferable to those already established by the Danish

* "Monogr. des Échinodermes;" Neufchâtel, 1841.

zoologist. His observations relate mainly to these organs as they appear on *Echinus lividus*, with a slight allusion to those of *E. brevispinosus* and *E. sphæra*. As mine relate mainly to the organs of *E. miliaris*, and as the details of the solid parts, as seen by me, differ in many respects from those figured and described by M. Valentin, I do not think it is altogether a work of supererogation to produce them; especially as the work of the French naturalist is not readily accessible to the English student; and no observations, in our own language, have been published, that I know of, since those of Professor Forbes in his "British Starfishes" above-cited.

M. Valentin considers it proved that the bodies in question are organs necessary to the economy of the animal.

Professor Agassiz, however, in a supplementary note to M. Valentin's Memoir, makes the curious suggestion that the *Pedicellariæ* may be the infant *Echini*, "which after their exclusion affix themselves on the skin of their mother. The striking resemblance," he goes on to say, "which the triple blades of the *Pedicellaria* bear to the dental apparatus of the Urchins has given me this idea, which will not appear paradoxical, if we consider the diversity of form assumed by the *Pedicellariæ* on the same Urchin; and especially if we recollect that the Feather-stars (*Comatula*), which subsequently become free, are in like manner stalked; and if we consider that certain Echinoderms undergo changes of form the most strange, as Mr. Sars has demonstrated in *Asterias*

sanguinolenta. The little that is known of the modes of development of the Radiate animals is calculated to excite our curiosity, and to prepare us for the most unexpected results."

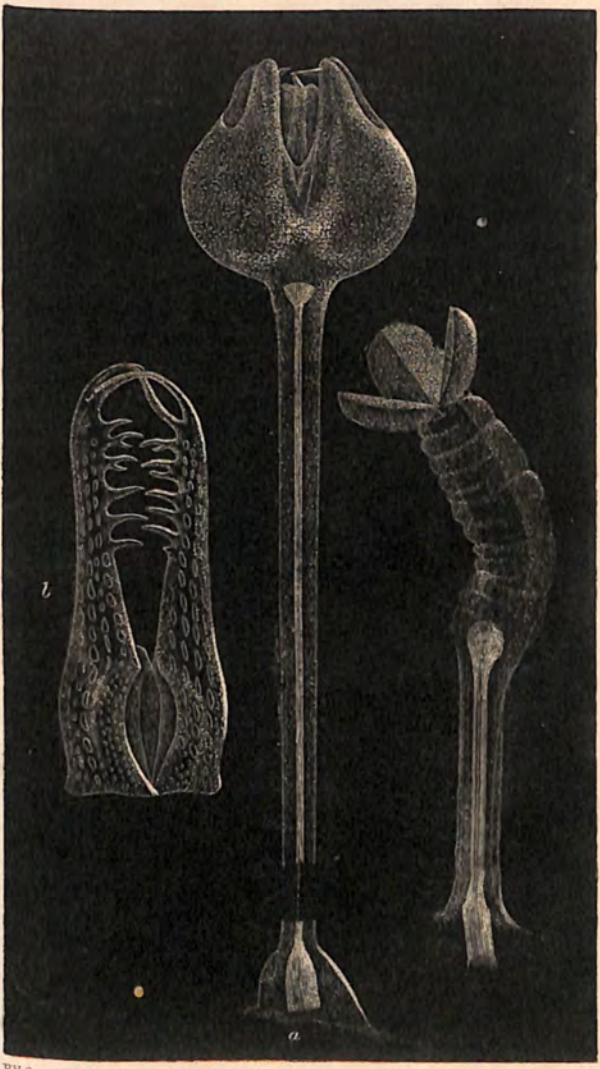
This suggestion is, I fear, altogether untenable, though ingenious and plausible. If the *Pedicellariæ* were embryonic forms, would they be always present, and stationary, as they are? for no one has yet found a Sea-Urchin without them. The continuity of the skin of the body with that of the *Pedicellaria* (which I have mentioned above in the case of *Uraster*) seems also to negative the notion of the former being in any sense parasitic. But the recent researches of Professor Johann Müller on the embryology of the ECHINODERMATA conclusively settle the question against M. Agassiz's supposition.

Mr. Arthur Adams, as recently as August, 1851, announces that he has discovered what he calls "a new species of *Pedicellaria* (*P. volutarum*), parasitic on the skin of *Voluta vespertilio*," a Gasteropod Mollusk; and this, he thinks, confirms the opinion of Cuvier and Müller, that the bodies in question are independent parasitic organisms. But I cannot help considering that there is some error in the observation.*

In Plates XI., XII., and XIII. are represented some of the forms above described.

Plate XI., fig. *a*. A spine of *Uraster rubens*, bearing several *Pedicellariæ*; considerably magnified.

* Ann. Nat. Hist.; 1851.



P.H.Gosse del.et lith.

Vincent Brooks Imp.

Pedicellariæ of Urchin.

b. A *Pedicellaria* from the same; more highly magnified.

c. The calcareous skeleton of the same.

Plate XII. The skeleton of the head of *P. tridens*, from *Echinus sphæra.*

Plate XIII., fig. *a. P. globifera*, from *Echinus miliaris.*

b. The skeleton of two of the divisions of the head of the same.

c. P. stereophylla, from *Echinus miliaris.*

XXVI.

TO AMRUTH CASTLE.

Disappointments—Fresh Resource—Tide at the Points—Magnificent View—Hedge Plants—Bryony—Foxglove—Wiseman's Bridge—Black Rock—Kilgetty—Caermarthen Bay—Amruth Castle—Tel Pin—Submarine Forest—Boring Mollusks—Traditions of Inundations—Cantre 'r Gwaelod—St. Issel's—Romantic Glen—Begelly—Thunder-shower.

July 25th.

Our Gumfreston friends had appointed to make a day at what they have named, from the abundance and fineness of the Flowering Fern growing there, Osmunda Cove. It is one of the indentations of the northern cliffs, a little on the Tenby side of Monkstone Point. We accordingly set out, with our esteemed friend, Mrs. Brett, whose taste and acquirements in several branches of natural history, skill in drawing, and conversational powers, gave such a charm to our parties and explorations. Neither of us knew the way to the place; and though we had been instructed at what point to turn off from the high-road, yet we found, as is often the case, that verbal directions were insufficient when we came into the presence of difficulties and dubieties.

We took the wrong turning, of cou se; waited for our friends a couple of hours; examined well the lane,

where, as there had been rain in the night, covering it with a soft mud, we could see distinctly that no carriage-wheels had passed before our own; and then concluded that they had given up the excursion.

Now what shall we do? Go back? That would be a pity, as we are out. Let us go on and have a look at Amruth Castle, which we see in the distance, on the blue shore of Caermarthen Bay. It was agreed; and on we posted to Saundersfoot, which I have before described to you. We hoped to save some miles of a road which we had already travelled, by crossing the sands. The tide was turned, and was already approaching very close to one point of rock that projected most of all. Still, there was yet a space of sand between the rock and the sea; and we saw that if we could round that point, there would be no further difficulty. It was not much more than half a mile distant, and we drove as hard as we could. The heaviness of the sand, however, made our progress slow; and when we got to the point, it was too late, and we had the comfort of knowing that a quarter of an hour more would have passed us.

We turned reluctantly, and wound round Hean Castle, by the charming road which is shadowed by the tall firs and oaks of the Park. After passing the gate and lodge, the road descends abruptly, and reveals a very beautiful prospect. In front the road winds away, enlivened by a procession of carts loaded with wet coal-slack from the neighbouring mines; the horses falling ever and anon upon their haunches from the steepness of the descent; elegant ash-trees overhang the road; and on the left are the tall oak

and beech woods of the Castle-grounds: beyond these fields chequer the summits of the cliffs that overlook the sea; while the distant background is made by a fine conical mountain descending to a bluff beyond Amruth, and the long sweep of sandy shore encircling the Bay.

The view was so magnificent that our friend could not resist the temptation of sketching it; while we sauntered along the hedge-side, admiring the Wood Spurge that forms numerous shrubs in this part, large and bushy, and conspicuous for their red stems; and the graceful creepers that had tossed their festoons and wild garlands about the stiff thorn hedge.

> "The slender Bryony that weaves
> His pale green flowers and glossy leaves
> Aloft in smooth and lithe festoons;
> And, crown'd compact with yellow cones,
> 'Mid purple petals dropp'd with green,
> The Woody Nightshade climbs between."
>
> BISHOP MANT.

There lingered yet also many a Foxglove, though in that "dismantled" condition sung by Wordsworth, destitute of beauty and grace, and greeted only because we delight in the recurrence of anything that has charmed us in past time.

> "——— the Foxglove, one by one,
> Upwards through every stage of the tall stem
> Had shed beside the public way its bells,
> And stood of all dismantled, save the last,
> Left at the tapering ladder's top, that seem'd
> To bend, as doth a slender blade of grass,
> Tipp'd with a rain-drop."

At the bottom of this road we come out again on the shore; where a river, turbid and swollen with the

late rains, and covered with brown foam, debouches under Wiseman's Bridge, from its course down a lovely verdant valley, on the left. The air was loaded with the fragrance of the Meadow Sweet, which was growing in great profusion in the marsh above the bridge. Close by was a little square building, now unroofed and ruined, but showing rosettes of ornamental brickwork in the walls. A barefooted boy told us that this had been a counting-house, where the accounts of the mines had been kept. A great rugged bluff rose just in front, called Black Rock, shaggy with heath and bushes nearly to the base. The Castle towards which we were going was visible beyond, and point after point receding still further on.

We turn inland up a winding road, bordering the valley of the stream, the scenery every moment becoming more lovely. Even the furnaces and tall chimneys of Kilgetty, seen up the glen, were so embosomed in the hedges and groves, as scarcely to interfere with the pictorial effect; and the houses of the village, just peeping over the top of the rounded hill, were suggested rather than displayed. The torrent, still swollen, showed, in the line of rubbish and mud high up on its banks, the evidence of last night's furious thunderstorm; and we heard of other results, in the sad fate of two men who were drowned in yonder colliery by the water bursting in, and in that of a man and a boy on horseback overwhelmed by a torrent at Whitesand Bridge.

Now the picturesque road winds along the sloping cliffs, close to the edge, affording us a sight of the

narrow beach of sand beneath, and the expanse of this beautiful Bay. Behind us we see Caldy Island, and Monkstone Point, and presently the end of St. Catherine's opens from the tip of the latter.

The descent towards Amruth looks across fine slopes of down-like rounded hills, chequered with fields, and running out into points, each the counterpart of the others, and all ending in low rugged cliffs. Close to the Castle, a narrow lane leads up a little dell, most charmingly wooded. Here we "picnicked" under shadowing trees; spreading our rug for a table-cloth on some hewn timber-logs, flavouring our fare with Hunger's patent sauce, and filling our cups from the stream that brawled on the other side of the hedge. Hence we had a good view of Amruth Castle on a slope in front, with mowers in the meadow between, its fir-groves behind, and the sea on the right.

It is a modern-looking castellated mansion, but probably of considerable antiquity; though the constant occupation of it has prevented the hoary tokens of age from appearing. It is believed, however, to have been the ancient residence of one of Arnulph de Montgomery's followers, when that feudal baron parcelled out the spoils of his conquest at the close of the eleventh century. At present it is a lunatic asylum.

We strolled down to the shore again,—a beach of shingle and sand, bounded by a series of headlands, gradually sloping grassy promontories, terminating abruptly in nearly perpendicular, but very rugged rounded bluffs, of ferruginous horizontal strata. Along

them runs one undulating black band, which an idler near said was a vein of culm, too thin to be worth working. A square cavern in the nearest head, which he named "Tel Pin," looks exactly like a door leading into the bowels of the mountain.

The tide was now high, or we might have seen traces of the submarine forest which spreads away on each side of the spot where we stood, reaching even to half-tide level. An old lame man, enjoying the luxury of a short pipe, was eloquent in his replies to our inquiries on the subject.

"People call it sea-turf; they cart it away for manure, and it all goes to earth: they put it on the barley and oats. Anybody can see it's wood, by the look, the grain. Shell-fish pierce it. 'Tis light stuff, but 'tis the *brine* in it that's the good. They get it at low water, springs or neaps, alike."

I had heard before of the existence of this ancient forest, now completely covered by the sea, and had received, through the kindness of Edward Wilson, Esq., of Hean Castle, specimens of the wood. Some of these are so soft and decayed, as scarcely to maintain their integrity; other blocks are perforated, as the old man truly said, with "shell-fish;" the shells of *Pholas candida* being ensconced therein as close as they can well lie without mutual invasion, and appearing to have been alive very recently. Other pieces are quite solid, resisting the knife and the saw as perfectly as fresh wood, and in no way to be distinguished from pieces of an old ship's timbers. These last are evidently oak, the former appear to be poplar; but I am informed that elm, willow, and alder likewise occur;

and that, after storms, trunks and roots are occasionally laid bare at the recess of the autumnal spring-tides, which have marks of the axe still fresh upon them, proving that the encroachment of the sea has been effected since the country was inhabited by civilized man.

Nor is this the only example of an extensive and permanent inundation on the Welsh coast. Traditions and orally preserved poems and proverbs combine with existing remains to indicate that in several places large tracts of country, once cultivated and inhabited, have been swallowed up by the invading ocean. The chief of these is the "Cantre 'r Gwaelod," or the Lowland Hundred, which occupied a large portion of what is now Cardigan Bay.*

We preferred to return by a different route from that by which we had come. Diverging from Hean Castle, we took the road on the right, which led up through the romantic and secluded little village of St. Issel's, close by the old square church-tower of grey stone; where a stream spreads itself, and brawls across the pebbly road, and passes with a whispering rush through the tunnel-arch of a rustic foot-bridge. The high road passed through a dark, deep wood, as dark as the "greenwood shade" can be in daylight, and then up a narrow lane almost as obscure, with luxuriant overarching ferns; among which Willy sought and found with great glee the pretty scarlet acid hedge-strawberries, while we elders enjoyed continually recurring peeps of the lofty tower, through vistas of trees.

* See Appendix, No. I.

Presently we emerged into the Narberth Road; first, however, catching a sight of Begelly on our left, with the church, as usual, conspicuously tall, and half hidden in noble woods.

A long-threatened thunder-shower begins to cast down great drops at us; the clouds, thick and black, seem to enwrap us round about. We endeavour to find shelter under rugs and cloaks. It passes off, however; and then what fine effects the sky presents, with the massy clouds rolling off, half darkness, half radiance, and all silver-edged! How rapidly they change, amalgamate, and separate, revealing great breadths of deep azure, to close them up again, and again to open them! Now all is overcast again; we shall surely have it now! But no; here is the White Lion, and here the Church, and here we are at home unscathed.

XXVII.

THE SEA-SPIDER.

Mr. No-body—Description of his Person—His Head and Eyes—Blood-circulation—Reversal of its Course—Peculiarities—Observations of Dr. M.-Edwards.

July 26th.

THERE is a minute marine Spider very common on most parts of the coast, crawling sluggishly upon the smaller sea-weeds and branching zoophytes, which seems, from its lack of centralization, to realize our infantile ideas of Mr. No-body; but zoologists have designated him as *Nymphon gracile*. Widely different from the Spiders of *terra-firma*, in which an abdomen, some ten times as bulky as all the rest of the animal put together, is the most characteristic feature,—the belly of our marine friend is reduced to an atom not so big as a single joint of one out of his eight legs; and though his thorax is more considerable, this is little more than the extended line formed by the successive points of union of the said legs. These latter, on the other hand, are long, stout, well-armed, and many-jointed; but, apparently from the lack of the centralizing principle, they are moved heavily, sprawled hither and thither, and dragged about like the limbs of an unfortunate who is afflicted with the gout. To finish his picture, let me add his head; the most

important item, you will say; and so it is, and the largest, too,—'bating those legs.

The head, then, of our singular subject is crowned with a short column, on the summit of which are placed four black eyes, set in square; these, under the microscope, gleam like diamonds, the light being highly refracted through them. It is their high refractive power that makes them appear black; for they are really polished lenses of transparent substance. Beyond this the head projects into a stout oval or cylindrical proboscis, terminating in a small mouth and stout jaws, and furnished at the sides with a pair of spinous palpi, and a pair of pincers with hooked fingers, somewhat resembling those of a lobster.

My friend Mr. Dyster just now called my attention to one of these little gentlemen, whose dimensions do not exceed those of a grain of millet. He had been interested in watching its singular circulatory system, which we then examined together. Each of the long and many-jointed limbs is perforated by a central vessel, the walls of which contract periodically with a pulsation exactly resembling that of a heart, by which granules or pellucid corpuscles of some sort are forced forward. At first we thought the waves of this pulsation proceeded only from the extremities of the limbs towards the body; but by and by we saw that the course was the reverse; and even, in one case, that in two contiguous legs (on the same side of the animal) the motion was upward in one and downward in the other, at the same moment. After watching it some time, moreover, we found it vary-

ing and uncertain; strong and regular at one time, weak and vacillating at another, and not rarely quite imperceptible.

On tracing the pulsating vessels downward, we found them to terminate in a *cul-de-sac* in the penultimate joint of the foot; but in the opposite direction each opened into the great longitudinal vessel of the trunk, which we examined with great interest, because of Dr. Milne-Edwards' supposition that it is the intestinal canal which ramifies into the feet.*

Neither of us could discover, with the utmost care, any connexion between this great vessel and the œsophagus. On the contrary, at the neck it distinctly divided into two branches, each of which ran forward (with a remarkable bend) into the proboscis, and terminated by a broad rounded *cul-de-sac*. It was much more difficult to trace the posterior termination; but it seemed to us both, that, at the base of the minute abdomen, the vessel became nearly commensurate with the cavity of the body, dilating so as to embrace on every side an oval bladder, the circulating corpuscles not passing on each side of this vesicle merely, but all round it.

The pulsation was totally unlike the peristaltic motion of an intestine, both in the central vessel and in that of the limbs; and the corpuscles themselves

* "M. Milne-Edwards has seen in the interior of these organs (the feet) lateral expansions of the intestinal canal, or *cæca*. I have distinctly perceived traces of these, under the form of blackish vessels, in divers *Nymphons*. This observation induces me to believe that these animals respire by the skin."—*La Règne Animal* (Crochard Ed.), p. 86.

did not assume the appearance of granules of food undergoing the process of digestion: they were moreover driven by the waves backward and forward, from end to end, and not only, nor principally, from the mouth towards the anus.

I ought to add that there was a circulation, very distinct, of corpuscles *outside* the walls of the vessels. Their direction was in general the reverse of that within, but apparently obedient to the same pulsating impulse. The extra-vascular circulation was seen in both the body and the limbs, but most distinctly in the latter, from their superior transparency.

XXVIII.

GILTAR.

The Burrows — Sea-reed — Eryngo — Insulated Rock — Inland and Seaward Views—Migration of Eels—Harvest-man—Its Parasites — Burnet-rose — *Chacun à son Goût*—Penally—Giltar—Dewberry—Flowers—View from the Summit—Caldy and St. Margaret's — The Sound — Proud Giltar — Funnel-Caverns—Pipit — Perforated Rock — Quarrying Limestone — Beauty of St. Catherine's — Sea-weeds — Burrowing Shell-fish — Popular Zoology again—Therapeutics.

July 27th.

I HAVE just returned from a solitary ramble to Giltar. It was a tempestuous morning, and the sea was breaking on the South Sands with such an arching grandeur that I expected something magnificent from that iron-bound line of shore of which Giltar forms the terminating bluff.

Crossing the fields behind the Town, I came down by the windmill to the stone lock which bars the little morass stream; where I dipped in hope of getting Rotifera for microscopical examination, but with little result. Thence across the Causeway to the Burrows, a series of low hills of drift sand, that borders the shore for about a mile. Dreary enough were these hills and dales, rising and falling in constant sameness, with a scanty herbage of that thin rigid grass

called Sea-reed (*Ammophila arundinacea*) piercing, but not hiding, the loose yellow sand. The Eryngo (*Eryngium maritimum*) was, however, abundant,—a much more interesting and more beautiful plant; its leaves, which are so rigid and spinous as to defy intrusion, are elegantly veined with white on a silvery green ground, and its prickly heads of flowers, which are green while young, becoming, as they expand, of a delicate lavender purple.

A great mass of broken rock stands isolated in the plain just behind the sand-hills, some fifty feet high, with a perpendicular face inland, but seaward a slope of turf carpeted with the tiny Burnet Rose, not in flower, Eyebright and Thyme, and studded with hundreds of the little Navel Snail (*Helix virgata*). I mounted to get a better view. Inland the scene is pretty, but nothing more. Gumfreston in the distance, and Nash's Cottages on the right, with the new Cemetery Church and the surrounding groves, and the marsh-lake in front, make the best points. To seaward all was gloomy and wild; the green angry sea below sparkled with foam, and the indigo clouds above gave some fine examples of light and shade.

Round the base of this solitary rock flows a little stream, deeply tinged with brown, probably from oxide of iron, not wider than I could step across, with a rushy border. It had overflowed and left mats of a large bright-green *Conferva* on the turf. In the brook my attention was arrested by multitudes of young Eels, wriggling along in the direction of the current. I counted a hundred that passed me in about two minutes; and they crowded on uninter-

ruptedly, occasionally diving into the mud at the bottom, when I made a clutch at one. They were all about four or five inches long. How strong is the power of instinct! A few months ago, these tiny fishes ascended the stream with an impulse that would have surmounted all barriers; and now they are descending with an equal intensity of determination. All our writers on Fishes speak of a double migration of the Eel: one, in the spring, of the young fry from the sea up the rivers; the other, in autumn, of the adults to the sea for the purpose of spawning. But what could this be? Their minuteness showed them to be this spring's hatching, yet their direction was uniformly and unmistakeably downward.

Among the thyme I noticed one of those long-legged cousins of the Spiders that are familiarly called Harvest-men. It was the common *Phalangium cornutum*. I was first induced to look at it by the under-parts appearing of a bright red hue, which, however, was derived from the Scarlet Mite (*Trombidium phalangii*) which so commonly infests the insects of this genus. I counted no fewer than forty-eight of the little pests all sucking the poor wretch's juices from his belly and legs. I examined this Spider with the more interest from its manifest resemblance to the *Nymphon* of yesterday; a likeness, not indeed of general form, but sufficiently apparent in its black eyes set on a pedestal, in its spined, many-jointed legs, its palps, and especially its pincers (*chelicerœ*). These, with their hammer-like jointing, the rear of the terminal moiety projecting like two curved horns upwards, formed the most singular feature in his phy-

siognomy. Formidable as they looked, their forceps were evidently powerless to rid the poor hapless creature of its blood-sucking tormentors. Strange seems the ordinance that one animal should be destined thus habitually to be sucked by fifty of another sort, carrying about its murderers wherever it goes! Possibly, however, the predisposition to plethora may be so inveterate in the fat-bellied Harvest-men, that all this sucking is only a needful degree of phlebotomy, highly conducive to health and comfort! What do you say to that suggestion? Ingenious, isn't it?

Farther on acres upon acres were covered with the lowly but lovely Burnet Rose, mostly in hip now; the glossy purple-black hips looking quite tempting, but, to the disappointed palate, both bitter and astringent. And yet to some palates these wild fruits would prove a prize not to be despised; for, as Aird says (perhaps with scarcely sufficient respect for the feelings of the juvenile generation), "that all-devouring gourmand, the school-boy, who crams every crudity into his maw, from the sour, mouth-screwing Crab up to the Swedish Turnip, sweetened by the frost, riots in the luxury of the Hip, caring not how much the downy seeds may canker and chap the wicks of his mouth, and render his nails an annoyance in scratching his neck." A few blossoms appeared most delicate in chaste whiteness,—"simplex munditiis,"—and exquisite in fragrance; just enough to indicate how beautiful and sweet this tract must have been a month or six weeks ago.

> "The rose looks fair, but fairer we it deem,
> For that sweet odour which doth in it live."
>
> SHAKSPEARE.

Penally has been developing for some time, at every step becoming more fully seen, and now full in view on my right. I mount a tall hillock, throw myself on a soft and springy bed of thyme, and admire. There is a most charming hill, half covered with copse, groves of elm and oak, and brush, interchanged with chequering fields, brown and green. Villas are peeping out everywhere; the white village clustering and cowering at the left foot of the hill, with the tall battlemented Flemish tower of the old Church behind, rising far above the trees, which hide the body of the building, all but the tip of the gable. Behind, Proud Giltar shows his dark head above the point of the hill. Larks keep springing up from the cover all round me, and soar, singing, into the sky; while brown Meadow Butterflies dance by scores over the thyme.

And now I have got to the foot of Giltar, and begin to climb the hill. The Dewberry is abundant, both in blossom and fruit; the former white and small, the latter large, covered with glaucous bloom, juicy, agreeable to the taste, and altogether as superior to the plebeian blackberry as a damson to a sloe. Up the steep, rocky, and sandy path, several other flowers attracted my notice, as the narrow-leaved Seaside Plantain, with its spikes of pretty yellow blossom, the always elegant Rest-harrow, the tall Spotted Orchis, the twinkling Eyebright, Milkwort of the azure variety, the little yellow stars of the Ladies' Bedstraw; and as I got higher and higher, the Bird's-foot Lotus, the pretty rosy Centaury, massive beds of the Yellow Stonecrop, and the graceful Kidney-

vetch, or Lady's finger; one plant of this species had several heads of blossom which were of a bright crimson, verifying Hooker's observation,—"With *red* and sometimes white flowers, in Devonshire and *Pembrokeshire*, mostly *by the sea*." * In general the blossoms are yellow or cream-coloured.

At the summit a magnificent sea-view bursts on the eye. The land recedes on the right, forming four successive promontories, all bold and abrupt, but the first and third are rounded, with a low spit at the base, while the second and fourth are perpendicular. The outermost of these must be St. Gowan's Head, the south-west angle of the Principality: the others I am not sure of, but Oldcastle Head must be one, probably the second.

Turning to the front, there are the two islands of Caldy and St. Margaret's, connected together at low water by a narrow isthmus of very ragged rocks, but now, as I see them, completely separated by a breadth of sea called the Small Sound. St. Margaret's seems quite close from this elevation, though it is about a mile off, divided from me by the strait called *par eminence* the Sound, now all whitened with the boiling and breaking sea. It is bold and cavernous, much like St. Catherine's; while Caldy is more gently undulating, and mapped out into fields.

Looking now again to the *right*, I see two miles of rugged precipices that terminate in the sweet little cove of Lidstep. The most conspicuous of them is Proud Giltar, towering haughtily over all his fellows. The nearer cliffs are broad slopes and sheets of flat

* British Flora,—*art.* ANTHYLLIS.

grey limestone rock, the strata having been perfectly denuded of soil, and generally retaining their integrity, though cracked all over, and cleft here and there with fissures. Caverns opening to the sea, with chimney-like orifices yawning in the slopes, occur frequently. I crept cautiously down the incline to the edge of one of these funnels, much to the annoyance of a Rock Pipit, who flew anxiously about from stone to stone, chirping sharply all the time, as if indignant at the unwonted intrusion. I could not see the sea at the bottom, but heard its wash and booming roar, as it dashed in; and some large fragments of rock that I dislodged, after bounding from angle to angle, made a heavy splash as they disappeared.

By creeping a little farther down the steep, I opened that fine perforated mass of rock that projects from the foot of the cliffs, much like the well-known London Bridge Rock near Torquay, and not at all inferior to it in picturesque boldness.

As I returned down the side of Giltar, I stopped to look at the quarry-men blasting the rock, and loosening the huge slabs with crowbars—a dangerous employment. A sloop moored at the foot of the cliff was loading stone; and the information supplied by a communicative workman, that it was shipped "to England" for the manufacture of lime, sounded strangely on my ear; for I had scarcely apprehended that I was not in England.

I came home over the sands along the edge of the arching waves, with St. Catherine's right in front, —a very striking object, especially as I could see

straight through the main cavern. I did not wonder at the universal admiration excited by this charming island, nor at the numerous efforts to perpetuate a remembrance of its beauty, which seem to be characteristic of the visitors to Tenby. A ragged donkey-boy who ran by my side, observed, on noticing that I stood to gaze on the islet,—"Gentry goes droo in a boat at high water; and they stops, and draas it all off in a pictur'."

The heavy sea had washed up many deep-water algæ, among which I found some magnificent specimens of *Delesseria sanguinea*. The burrowing Shell-fishes, too, had been washed out of their holes, and had become the prey of the vigilant Gulls, always alert to profit by a storm. The local names given by the uneducated to the less known or more lowly invertebrate animals, are, as I have said before, a subject of interest to me. My little bare-legged companion was communicative on this point too. The common *Trochus umbilicatus* he called "Sweet William;" the *Mactræ* were "Cockles," and the *Solen* was a "Hay-fish." He enlightened me on the difference between the hole of the "Cockle" and that of the "Hay-fish;" that the latter is deeper, and that the "fish" retires more rapidly on alarm; but he cautioned me on the danger of putting my finger into the burrow, as "the Hay-fish would break it [the finger] all to pieces." Then our conversation grew discursive, and the health of his donkey was the subject of lamentation. He hoped that the poor beast would live through the winter, for Good Friday would set him all right. "We gives the Cross-buns to the donkeys, and to all kinds of cattle; and they always cures 'em of everything;—Mother always does!"

XXIX.

LUMINOUS ANIMALS.

Beautiful Phenomenon—Ceratium—Its Form and Manners—Its Proboscis—Power of emitting Light—Synchæta—"Great and Small"—Its Organization—The Eye—Mouth—Stomach—Contractile Bladder—Muscles—Ciliary Disk—Foot—Elegance of Appearance and Movements—Larva of unknown Annelid—Analogies with Rotifera—Larva of Spio?—Marine Animals in Fresh Water.

July 28th.

LAST night the water within the little harbour was splendidly luminous. No trace of light, however, appeared on the smooth surface; but when this was agitated, it blazed. The finest effect was produced by dashing a large stone down from the quay; every drop of spray that splashed up was luminous; and thus a momentary star of many irregular rays of light was made, some of the lines reaching to fifteen or twenty feet. At the same moment a great circular wave was raised, which took the appearance of a bank, or annular agger, most intensely lustrous, but so transient that the progression of the wave could not be traced: the light sank into darkness in an instant. The Bristol Steamer was just on the point of starting; and an impatient stroke or two of her paddles now and then illuminated the dark water under her quarter; and the lowest step of the Quay Stairs was every instant covered with sparks, like

diamond dust, by the tiny wavelets that washed over it and rolled off.

I ran home for a bottle and secured a dip. The *Noctiluca* was sufficiently abundant to account for the radiance; but there was also a singular creature even still more minute, in great numbers, which belongs to a genus enjoying a luminous reputation. It is a species of *Ceratium*, one of the INFUSORIA, not described, so far as I know. It is spindle-shaped, swelling into a globose form in the middle, and tapering off into a long spine at each extremity. A deep groove runs round the middle, the edges of which show ciliary action. The division which proceeds foremost in swimming has an accessory spine much shorter than the other, apparently jointed to it close to the groove, but pointing in the same direction. All the spines are straight. The two divisions may be compared to two valves of a shell, being firm, transparent, and resisting; their surface is delicately punctured or stippled. The contents are granular, and of a rich yellow.

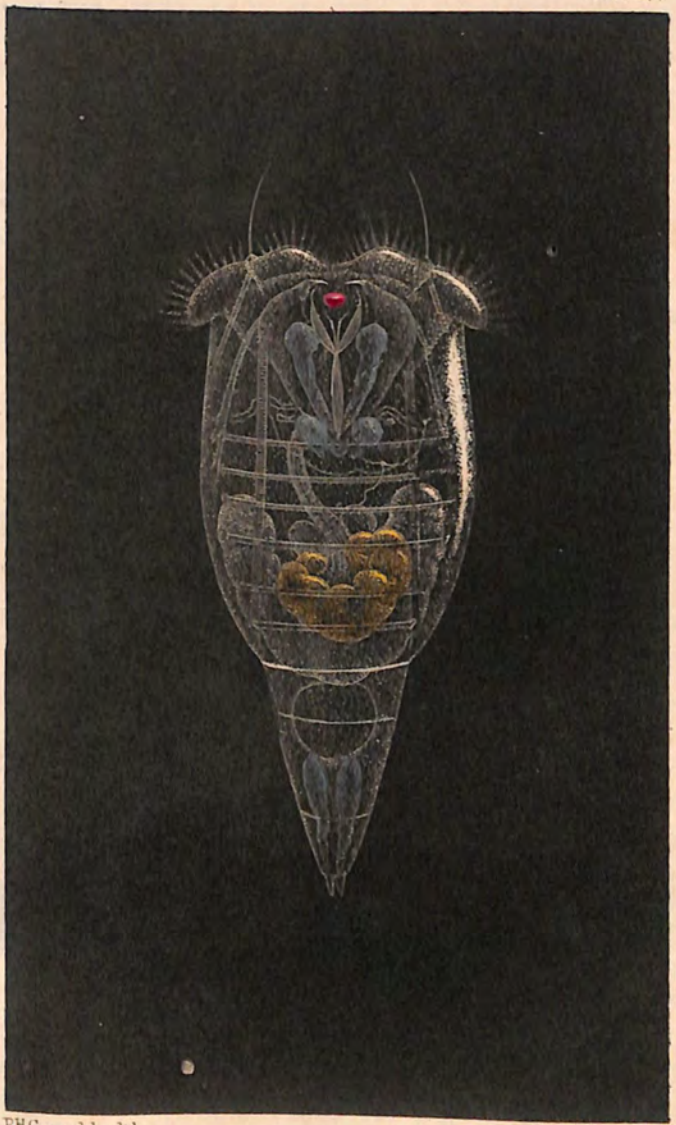
When alive these animalcules swim fast, with an uniform gliding motion, the single spine foremost, occasionally revolving on the longitudinal axis; and throwing about in all directions a flexible proboscis of excessive tenuity, two or three times the length of the whole body. This appears to proceed from an orifice in the shell (*lorica*), situated in the two-spined valve, not far from the ciliated groove. It appears like a waving line of light, whisked about with a lashing motion, and occasionally contracted into wrinkles, and apparently withdrawn into the shell.

After death, every specimen that I examined protruded the internal parts, in globular vesicles of delicate subtilty, varying in size, which seemed to ooze out from apertures in the *lorica*. The animals averaged $\frac{1}{170}$th of an inch in length, and $\frac{1}{480}$th in width.

It is probable that much of the phosphorescence last night may have been dependent on this animalcule. Ehrenberg says of *C. tripos*, a species which in some positions might be mistaken for this:—"The power of this creature to evolve light is placed beyond all doubt, as I took up nine phosphorescent drops, one after the other, from the water; and I saw nothing else in each than a single animalcule of this species."

Synchæta Baltica occurred in the same water. This is the more interesting, because it is one of the species supposed to produce the luminosity of the ocean; and because other observers have found it associated with the little horned animalcules just described, though there is no affinity between them; the *Ceratium* belonging to the very low Class INFUSORIA, the *Synchæta* to the far more highly-organized ROTIFERA.

This beautiful little creature seems to have been first seen by Baster about a century ago, and attracted his attention by being vividly luminous. In 1830, Dr. Michaelis found similar luminous animals in the Baltic, at Kiel. "I procured from him by request," says Dr. Ehrenberg, "some of that luminous water, and it shone brightly still. I isolated the INFUSORIA, among which was this *Synchæta*, but I saw no light from it: on the other hand, a little *Polynoe*,



P H Gosse del et lid.

Vincent Brooks Imp

The Luminous Syncheta.

which I named *P. fulgurans*, shone quite brightly. In August and September of 1832, I again obtained such luminous sea-water, and saw again the great *Synchæta* twice; yet it never shone, but the light was produced by the little *Peridiniadæ* (*Ceratium*)." *

I do not know what idea you may have formed from the Prussian Professor's phrase, "'the *great Synchæta*;" but perhaps you will be surprised to learn that my specimens measured about $\frac{1}{125}$th of an inch in length, and but $\frac{1}{350}$th in width. Yet, after all, "great" and "small" are comparative terms; and, contrasted with those Monads which sport about and enjoy existence under the dimensions of $\frac{1}{1000}$th of an inch, the *Synchæta* may be considered gigantic, though actually invisible to the sharpest unassisted sight. But it is a beautiful creature, lively in its movements, and rich in its organization. Its form is that of a long cone, when viewed in front, but bulging out in the back, when looked at sidewise. It is as clear as glass, and perfectly colourless, except that its stomach is usually distended with yellow food, and that it carries a large red eye, which glitters like a ruby. This brilliant organ of vision is not situated, however, where you would perhaps expect it, on the front of the head or on the facial edge, but in the midst of the body. At least, it so appears when you look at the animal from the front or the rear; but when you obtain a side-view, you perceive that it is a lens seated on a great prominent ganglion, which juts out behind from the head-mass, and is therefore much nearer to the skin of the back than to

* Die Infusionsth. ; p. 438.

that of the breast, though still a good way within the cavity of the body. The perfect transparency of the integument precludes any impediment to sight from this situation, while it affords protection to the organ.

In front of, and a little below the eye and its ganglion, there is the great *mastax* or muscular mouth. This organ also is freely suspended within the body, communicating with the exterior by a partial turning inside-out of a tube, which at other times extends between this strange mouth and the front of the head. In the interior of the mouth are seated the two pairs of glassy jaws, of most singular form and mechanism, the tips of which are occasionally protruded from the head and fiercely snapped.

From the back of this mouth—which, when seen free in the body, looks like a great three-sided or pear-shaped mass—descends a very slender tube, which is the gullet, and which conveys the masticated food down to a sacculated stomach. This also hangs loosely in the conical body, and, as I said, is usually tinged yellow from its contents. On its summit it carries, one on each side, a pair of globular clear vesicles, which are understood to be pancreatic glands, answering to what is called the sweet-bread in quadrupeds, and serving to secrete and pour into the stomach a fluid helpful to digestion. The stomach leads to a short intestine, which terminates by an orifice near the pointed extremity of the body.

Beside this, there lies a curious organ, the use of which has not been satisfactorily made out, though, as it is found in all the ROTIFERA, it doubtless performs an important part in the general economy, probably con-

nected with respiration. It is a globose bladder, which gradually becomes distended with a clear fluid, when it suddenly contracts to a point, discharging its contents through the common orifice. Then it immediately begins to fill again, and in the course of a few seconds again contracts, and gradually fills again. When full, it forms, from its brightness, a very conspicuous object in the animal, looking as if a round hole had been cut through the body. (See Plate XIV.)

All these internal organs, and especially those in the fore parts of the body, are thrust forwards or dragged backwards, or swayed from side to side with the most vigorous and wayward movements, by means of numerous muscles; many of which are distinctly seen, in the form of glassy threads and cords passing perpendicularly, diagonally, or transversely, from one part to another. The action of these materially alters also the outline of the body, especially by drawing in and infolding all the anterior parts, completely concealing the rotating organs.

When these last, however, are expanded, as they are when the animal is swimming, the front of the head forms a broad truncate disk, slightly elevated in the middle, where a pair of stiff bristles spring from a pair of warts. On each side is a great lobe, which ordinarily depends like an ear, but which can be partially elevated. The whole front is set with vibrating cilia; but these ears are more richly furnished with these organs, the movements of which produce powerful circular vortices, and thus subserve the capture of prey, as well as locomotion.

The hinder extremity of the body, or the apex of

the cone, is protrusile, by means of sheathing or telescopic joints, like the extremity of a fly's body; and the last joint is formed by a pair of minute pointed toes. In many of the ROTIFERA, these organs act as a foot in supporting the body when at rest; but they seem not to be so used in this genus. Indeed, I have never seen this species, and rarely any other of *Synchæta*, at rest at all; it is invariably seen swimming at large.

The crystalline translucency of the whole body renders this tiny animal a particularly charming microscopical object, and as instructive as it is beautiful. Its motions, too, are all vivacious and elegant. It shoots rapidly along, or circles about in giddy dance, in company with its fellows, sometimes near the surface, at others just over the bottom of the vase in which it is kept. Occasionally the foot with the tiny toes is drawn up into the body, and then suddenly thrust down, and bent up from side to side, as a dog wags his tail. Sometimes the two ear-lobes are brought forward, and then spasmodically spring back to their ordinary position, when the little creature shoots forward with redoubled energy. In all its actions it displays vigour and precision, will and intelligence. In short, it is one of those "minims of existence" which exhibit the power of God as much as a sun or a system of planets.

Plate XIV. represents the Luminous Synchæta, highly magnified.

In another phial of water that I dipped at the Quay Steps, and which was, without being very

luminous, well supplied with *Noctilucæ*, I found some animals that appear to throw light on the affinities of *Chætonotus*, another Rotiferous form. One of these I lost; but a second, which was considerably larger, I examined in detail. It is analogous to some that swarmed in a phial last spring, in which was a numerous colony of *Spio seticornis*, but nothing else that I could recognise, except *Entomostraca*. This specimen may indeed be identical in species with those, but more advanced in development, being $\frac{1}{30}$th of an inch in length. But it is evidently closely allied to my genus *Dasydytes* (*vide* Ann. N. H. for Sept. 1851), and therefore to *Chætonotus* of Ehrenberg.

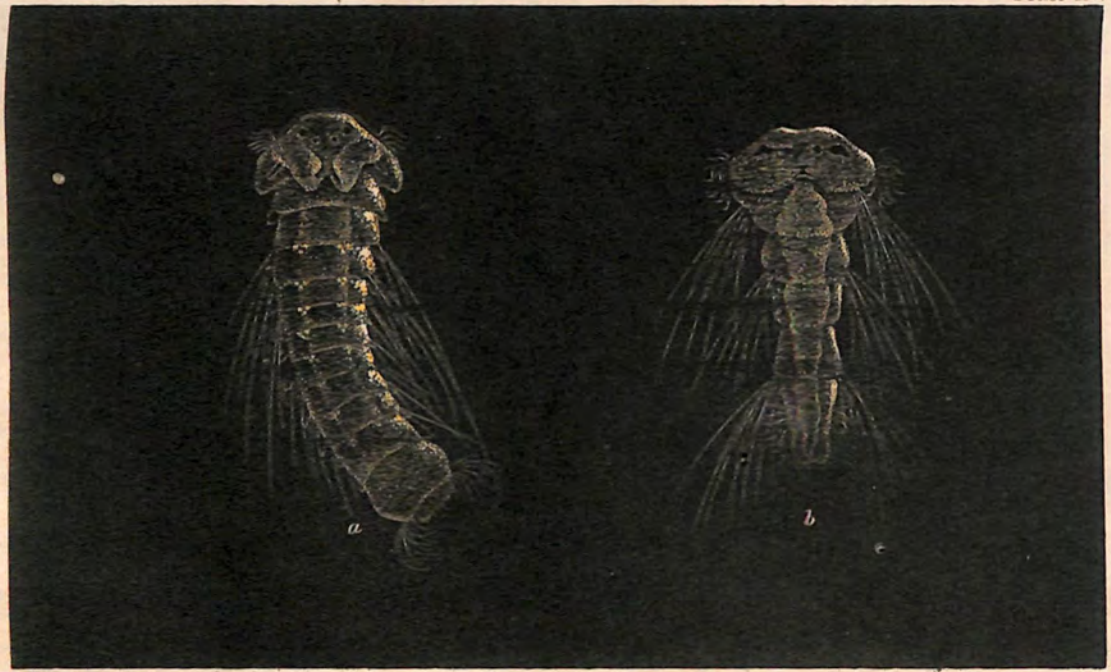
Now there cannot be a doubt that the present marine animal is a Nereidous Annelid in an early, but comparatively advanced stage of development. (See Plate XV., fig. *a*.) Its broad lobed head is furnished with four black eyes, set in semicircle, as in *Nereis*, *Syllis*, &c.; its body is divided into segments, of which ten are distinct, and the remainder affords indication of the future separation of more. Each segment bears on each side a double-lobed foot, of which the inferior ramus is lanceolate, and the superior has on its dorsal aspect a tubercle, from which issue a bundle of bristles, about three in number, some of which are half as long as the whole animal.

Yet, with these decided Annelidous characters, there is a good deal that shows relationship with the obscure Rotiferous forms that I have mentioned. The whole front of the head, and the truncate posterior extremity, are beset with strong straight cilia, the vibration of which is incessant. Besides these, there

is on each side of the head, and on each side of the ventral aspect of every segment, a pencil of long hooked hairs, which are vibratory or motionless at will; the motion of these is ciliary, and the effect of the whole is to make circular vortices on each side of the body, similar to those produced by *Chætonotus*, and by the wheels of the ROTIFERA. In addition, there is at each angle of the hinder extremity a pencil of hairs, but longer, which are also vibratory. *Dasydytes antenniger*, it may be observed, has a similar pencil of hairs at each posterior angle. The intestinal canal is simple, straight, and very wide; water percolates into it continually, through a broad funnel-like œsophagus, contracting into a muscular neck, the diameter of which is constantly varying.

While under the microscope, the substance of the animal gradually separated, by a spontaneous dissolution, into pellucid globular granules, without any apparent rupture of the integument. A large portion of the flesh was thus dispersed before voluntary movements had ceased. This dissolution presents an analogy with the INFUSORIA.

The larvæ, which I presumed to be those of *Spio*, were much smaller; being only $\frac{1}{60}$th of an inch in length. The head and first body-segment were very large; the eyes were placed nearly in transverse line, and the external pair were ill defined. The body was divided strongly into four segments, and, indistinctly into seven. The head, the second segment, and the third, were furnished, on each side, with a pencil of long curved bristles, from ten to sixteen in each pencil. The sides of the head, and the whole



P.H.Gosse del. et lith.

Vincent Brooks Imp

Young Annelides.

of the last segment, were beset with stout vibrating cilia. In swimming, the body was frequently bent into an arch; and at the same moment all the pencils of bristles were thrown forward, diverging in all directions, like the quills of an irritated porcupine.

Plate XV. represents the above-described Annelidous larvæ, highly magnified.

Fig. *a.* The larger kind, species unknown; magnified 60 diameters.

b. The smaller, supposed of *Spio seticornis;* magnified 150 diameters.

The power which some animals have of sustaining with impunity circumstances which are fatal to others closely allied to them, is remarkable. To most marine animals immersion in fresh water is instant death. Some young Crabs in the *Megalopa* stage which I found in luminous water, and which remained several days alive and well in a bottle of sea-water, died instantaneously on being dropped into a tumbler of fresh water. On the other hand, a specimen of *Eurydice pulchra,*—one of two that occurred in the same dip,—manifested not the slightest inconvenience at the change, but continued *for several days* to dart about in the fresh water, to shoot round and round the vessel, with intervals of motionless, death-like repose on the bottom, and behaved in every respect in a manner identical with that of his fellow that was allowed to remain in his native sea-water. I could not perceive the least abatement of liveliness or health, as resulting from the change of element.

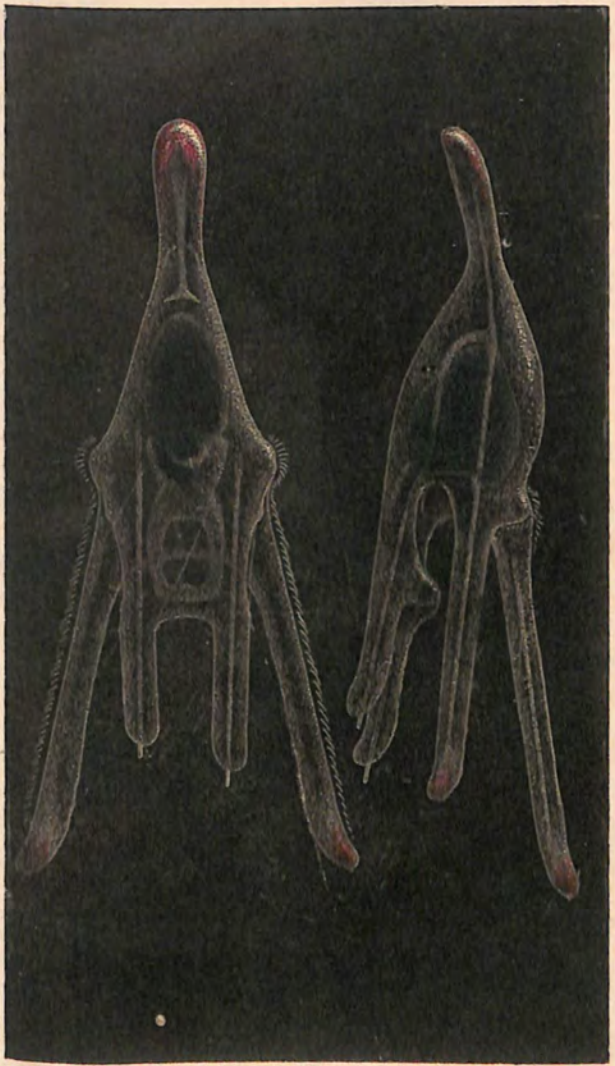
XXX.

YOUNG SEA-URCHINS.

The Larva—Its supporting Rods—Bell of Flesh—Mouth and Stomach—Cilia—Another Species—Probable Identification—Differences of Structure—Strange Development of the Urchin—Observations of Professor Müller—Appearance of Disk—Of Pedicellariæ—Of Suckers—Of Spines—Evanescence of the Bell—Further Progress.

July 29th.

THE luminosity of the sea last evening tempted me again to examine it for microscopic creatures, and I was well rewarded by finding an object of the highest interest. I knew it in a moment to be the larva of one of the ECHINODERMATA, from having seen the figures of Professor Joh. Müller; but this was the first time I had ever seen a living specimen. Indeed, I believe it is the first specimen that has been seen by any one in the British seas. (See Plates XVI. and XVII.) It is (as are all the larvæ of this Class) so totally unlike the parent form, and every other object that I am acquainted with, that I fear no description will give much idea of its appearance. Perhaps a painter's long-easel comes the nearest to it; for it consists of four long legs or rods, arranged two in front and two behind, with connecting pieces going across in a



PHJosse del et lith. Vincent Brooks Imp.

Young Sea-Urchin

peculiar manner, and meeting at the top in a slender head. The whole of the rods which make the framework are calcareous; and wherever the thickness will allow, they display that peculiar structure so characteristic of the Sea-Urchins, that any one who has ever seen it will know it again—I mean the excavation of the substance into a multitude of oval cavities, set in rows, so close as to admit no more solid matter than just suffices for the maintenance of its integrity. The edges of the larger pair of rods were beset with short spines, apparently the commencement of interspaces between other rows of cells; and hence I judge that the calcareous particles are deposited at certain points, which, meeting and coalescing, leave cavities vacant.

The whole framework is invested with a clear gelatinous flesh, which, for about half-way down from the summit of the cupola, forms a continuous tunic; but thence downward merely covers the four rods individually, without mutual connexion. The interior of the body is occupied by a large oval cavity (the stomach); and in the flesh that connects the bases of the shorter pair of rods, there is another excavation, with a large square opening, the margins of which are highly sensitive and contractile. This large opening, however, is not on the exterior, but on the interior surface of the cupola; for the common integument is stretched across as seen from the outside; as is distinctly shown by its contractions, and by the red glands which are scattered over it, as also over every part of the surface of the creature. These red glands are no less characteristic of the integument of the Echinoderms than the cells are of the calcareous

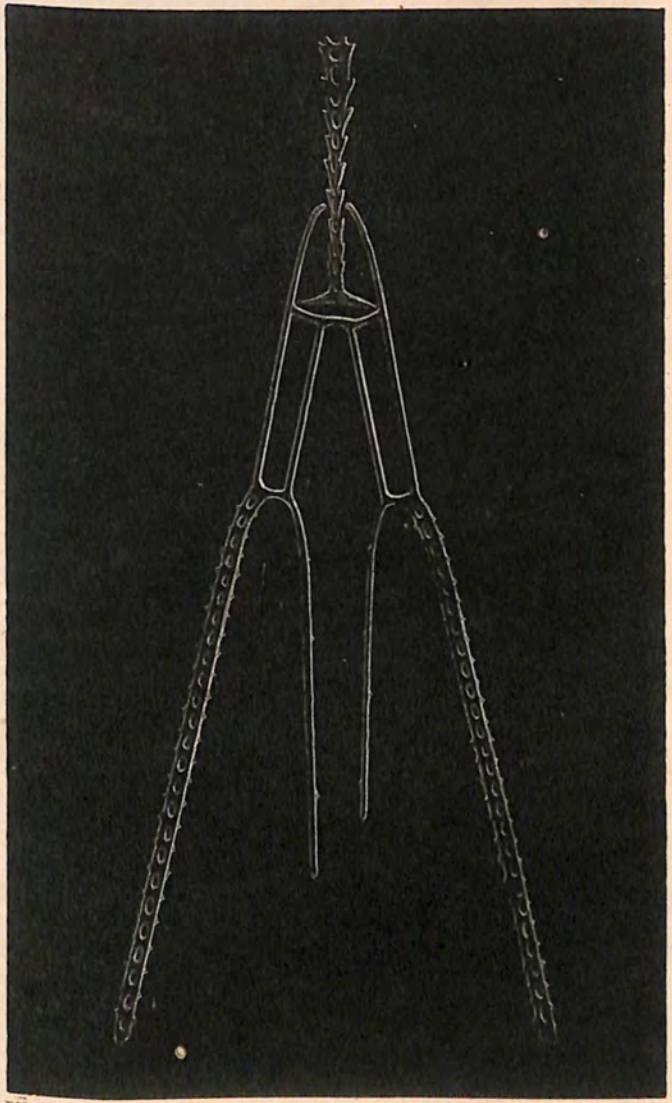
solids; for I have found them on the soft parts around the mouth, on the suckers, and on the *Pedicellariæ*. The square opening is the mouth, and the lower excavation the œsophagus, which is inserted into the lower part of the stomach and embraced by it, just as the end of a funnel passes into the bung-hole of a barrel.

The rods are clothed with long vibratile cilia, the motion of which is very apparent, especially at the hip-like projections or "epaulettes" at the bases of the longer rods. The whole creature was pellucid white, except the summit of the head-rod and the tips of the longer pair of foot-rods, all of which were somewhat tumid, and filled with pigment granules of a beautiful rose-colour. Its motions were slow and sluggish; but its appearance particularly elegant, though bizarre. Its total length was about $\frac{1}{40}$th of an inch.

This form is exceeding closely allied to the larva of *Echinus* found by Professor Joh. Müller at Nice in the month of August, and which he has represented in the Transactions of the Berlin Academy for 1850, plate viii., figs. 11 and 12. The framework of calcareous rods is, however, more developed in my specimen, in the upper part of the dome.

I subsequently found a second specimen, with important specific differences from the former, but agreeing in all essential particulars with some figured by the German zoologist, from individuals taken by him at Trieste in April.* Herr Müller identifies his larvæ with the Purple Egg-Urchin (*E. lividus*), a fine

* Op. cit.; pl. vii. figs. 4—7.



PH Gosse del et lith. Vincent Brooks Imp.

Skeleton of Young Urchin.

species, which, in the British seas, is peculiar to Ireland, where it inhabits hollows excavated by itself in the limestone rock. The nearest British species to this is the Purple-tipped Egg-Urchin (*E. miliaris*), which is very abundant on this coast. Hence it is most likely that the larva I am about to describe is that of *miliaris*; and, if so, the former probably belongs to *E. sphæra*.

My second specimen agrees in general with the former, with the following differences. First, there is an additional pair of rods, making six in all; namely, the long posterior pair, the anterior pair, which border the mouth, and a lateral pair outside these. These last are short; and, after passing upward to a level with the outlet of the œsophagus, terminate by two minute branches within the flesh. The lower extremities of all the rods project considerably beyond the flesh which invests them.

Secondly, there is no projection of the calcareous framework into an apical rod; the long posterior rods not being even united at the dome. Their upper ends are dilated with chisel-shaped extremities, and they simply incline to each other, and appear to be in contact without any union.

This specimen I have delineated in Plate XVIII.

The development of the *Echinus* out of this exquisite little cupola of living jelly is something even more startling than that of the *Balanus* that I lately described. That was a process of successive moultings or casting of the skin, which every child, who has bred a caterpillar to the chrysalis, and this to the butterfly, is familiar with, at least in principle. But

the construction of the Sea-Urchin is not a process of moultings, nor has it any known precedent in the whole economy of zoology, with which we may compare it. Perhaps the best illustration is that suggested by the illustrious discoverer, who compares the relation of the Urchin to the larva to that of a picture to its canvas, or that of a piece of embroidery to the frame on which it is worked.

According to this observer, the first trace of the future *Echinus* appears as a little convex disk or circular shield within the dome, not placed symmetrically, but on one side, close to the arch formed by the flesh stretching from one of the anterior to one of the posterior rods. Having compared the dome to a clock-case, of which the hanging œsophagus and mouth form the pendulum, he calls this little disk the face of the clock, only it is at the side instead of the front. Soon this disk begins to display markings, making the figure of a cinquefoil; and other marks soon follow on the margin, in the interspaces of the pattern. The stage in which the disk is seen corresponds in Herr Müller's figures to my second specimen. I saw no trace of such an appearance, indeed; but this may have been owing to my having looked only at the opposite side. Yet I can scarcely imagine how I could have overlooked it, had it been present.

Meanwhile infant *Pedicellariæ* begin to appear; and, strange to say, not on the disk which is to become the Urchin, but on the interior of the dome, which is to be absorbed, and even on the opposite side from that of the disk. These organs are commonly four, arranged in two pairs; they already have

the stem, and the three-bladed heads formed, which exercise their characteristic movements of opening and shutting.*

Now the *sucker-feet* of the *Echinus* appear; five of these organs, most disproportionately large, projecting from points on the margin of the disk. Soon after these, fleshy cylindrical columns begin to spring up from the surface, which presently develop within their substance a framework of solid calcareous matter, excavated into cells in the characteristic manner; and thus they are seen to become incipient *spines*, with the power of rotating upon their bases.

At this time the young *Echinus* is capable of crawling along by means of its suckers, whenever it is brought into contact with a supporting body; though the ciliated fringes of the domular larva yet remain, and carry it through the water with that majestic gliding motion, which has up to this time characterised it exclusively.

The dome, however, has begun to disappear before this stage is attained, the flesh gradually wasting, together with the calcareous rods; all this exquisitely modelled, cancellated, glassy structure passing away insensibly, no one knows how. The stomach and œsophagus, indeed, are by degrees sucked into the ever-growing disk; but all the rest, flesh and rods, epaulettes and cilia, are absorbed or dissipated.

The progress of the young *Echinus* has not been traced much beyond this point; but Professor Müller

* The existence, thus early, of *Pedicellariæ* is itself conclusive against the suggestion of Professor Agassiz, noticed *ante*, page 249.

has obtained specimens, still swimming freely on the surface of the sea, in which only slight rudiments of the glassy frame remained. These spherical, flattened disks crawled on the glass in which they were kept for observation, just like an *Echinus*, moving their spines separately and independently, and extending their suckers to take fresh hold with them.

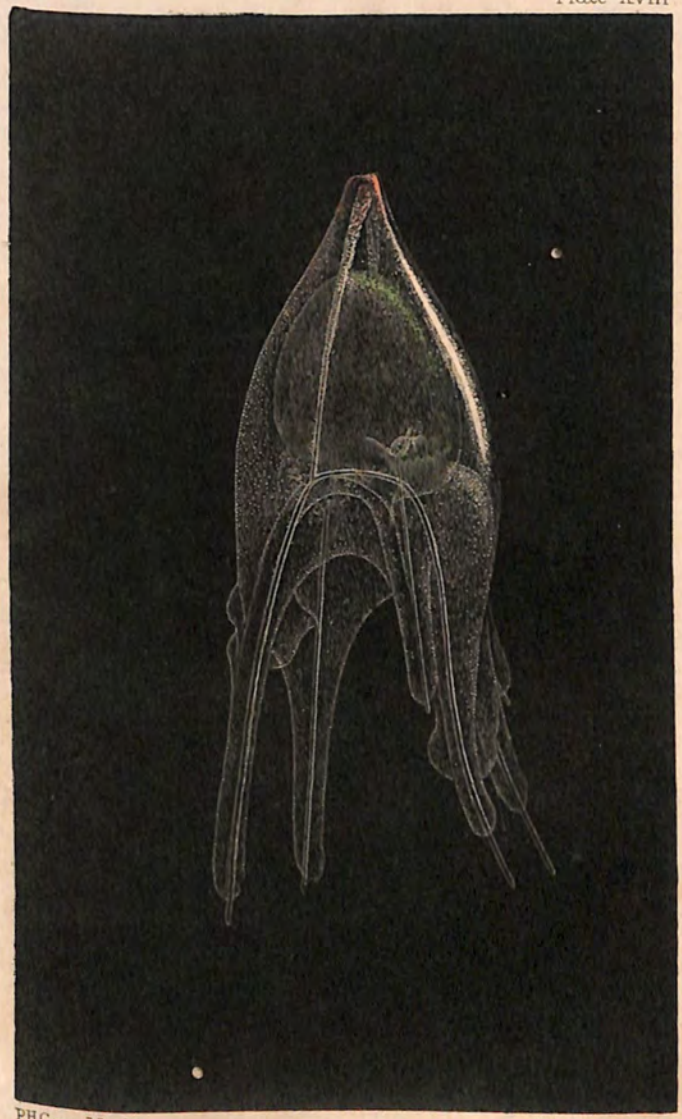
Plate XVI. represents the first-mentioned larva of *Echinus*, much magnified.

Fig. *a*. Front view.

b. Side view.

Plate XVII. The calcareous skeleton of the same.

Plate XVIII. The second larva of *Echinus*, presumed to be that of *E. miliaris*.



P.H.Gosse del. et lith.

Vincent Brooks' Imp.

Young Sea-Urchin.

XXXI.

VIEW FROM THE CROFT.

Evening—Penally—The Ridgeway—Poole's Cottage—Carmarthen Bay—Gower—Tenby—Character of the Landscape—A brilliant Sunset—Shelley's fine Simile.

August 1st.

I AM very fond of fine expansive landscapes, as you are probably by this time sufficiently aware. Permit me to describe to you one more; though I know a verbal enumeration of details is a poor substitute for the gratification of which the visual organ is the seat, when we look upon that which is grand or beautiful, and, as it were, drink in its grandeur or beauty without an effort.

It was a lovely evening; and my wife and myself had been taking a walk along Croft Terrace and the edge of the northern cliffs. The sun was setting in gold-edged clouds, when we stood on a peak, and turned inward to the wide and charming prospect that was spread before us. Beginning on the left, there were the summits of the Penally hills, with the peeping houses; then the slope of that noble, elevated road, the Ridgeway, receding into the distant dimness. In the half-distance were many villas and ornamental cottages embosomed in beautiful trees;

the old and the new Narberth Roads diverging from the town, and the pretty new Church between. Then, more in front, a deep bushy dell, with the buildings of some manufactory clustering in the bottom; the vale itself leading up to the right among the hills, with a narrow winding footpath along its side. On the right was Poole's Cottage, on the very top of a lofty rounded mountain-head, descending abruptly to the water's edge.

Behind us was the whole sweep of the Bay, a grand semicircle of thirty miles, ending in the bold blue promontory of Gower, far out on the horizon. Thence the eye came home across the silvery sea to Tenby Head with its ivy-crowned castle, the busy pier, the white houses of the town, the wood-fringed cliffs, and the smooth sands beneath; till it rested on the Croft close beside us.

There is something particularly exhilarating to the spirits in standing on some commanding elevation, and gazing far, far down from the dizzy height; as we did on the yellow sands almost literally under our feet, where the people, taking their evening stroll, "appeared like mice," as Shakspeare says; and the confused sound of their voices, mingling with the whispers of the surf, came faintly up to our ears, telling us how remote we were from the living world.

Expanse and soft verdant beauty were the prominent characteristics of the inland prospect; in which variety was imparted by the varying distances of even like objects, and by the different tints of green in the fields, trees, and hedges. Then there was a richness communicated to the whole by the glow of the red

horizontal sunlight cast over all, and bathing all, until the fiery orb sank into his bed of clouds. And after that another charm came from the fantastic forms of those very clouds; which, as soon as the sun was set, seemed to grow suddenly greater and blacker, palpably and massively dark, and to be heaped pile on pile, shooting up pinnacles, and spreading out long ragged points, with the clear burning brightness opening between, and shining through them, like the brilliance of an illuminated palace, through its gates and windows. We could not help recalling that fine simile of Shelley's, on such a sunset as this :—

> "—— when the north wind congregates in crowds
> The floating mountains of the silver clouds
> From the horizon,—and the stainless sky
> Opens beyond them, *like eternity.*"

XXXII.

KNIGHTSTON POND.

Knightston—The Pond—Moor-hens—Rotifer-fishing — Implements —Operations—Examination of the Dip—Various Animalcules —Various Localities for dipping—Forest Road—Corn-fields.

August 5th.

THE Mayor of Tenby, W. Richards, Esq., has a very pretty estate called Knightston, a large portion of which is covered with young and flourishing plantations. In one part there is a secluded fish-pond, which I wished to investigate for aquatic animals.

A mile of the Narberth Road brought me into the woods; and suddenly I came upon the pond—a little retired lake, motionless and glassy, reflecting with unruffled truthfulness the willows, and ashes, and firs that dip their branches into its bosom; for it is surrounded on all sides by the woods, which grow down close to the water's edge. The many-coloured foliage all around added to the beauty of the place; for the trees had already begun to feel the influence of autumn in "the sere and yellow leaf," at least in patches, and other hues were contributed by purple beeches and various foreign ornamental trees. At the farther end, white Water Lilies were floating in queenly beauty; and the Myriophyllum and Potamo-

geton were abundant enough to promise me a good fishing in my *very* small way.

Several Moor-hens, alarmed at my unpolite intrusion, bustled along, splashing up the surface, and hid beneath the overhanging branches of the margin; where, however, in spite of their caution, they could be detected by their scarlet foreheads. Now and then they squeaked and called to each other from opposite sides of the pond; and one and another would dash across by the united efforts of wings and feet, leaving a long rippling wake behind, and then squeak, as if to communicate to his friends behind the interesting fact that he had found a much nicer place;—just as Paddy writes home from America his success in emigrating, and a benevolent desire that his acquaintance should imitate his desertion of the "ould counthry."

I passed half round the pond, and, taking my post on the mill-lock, began my fishing.

Now, fishing for ROTIFERA and such small game is no very elaborate affair. Two or three ounce-phials, a walking-stick, and a bit of twine, make up your materials;—but stay, you ought to have a triple lens in your waistcoat-pocket, too; else you won't know whether you have caught anything or not. Now, then, for operations. You take one of your phials, and, clapping the neck of it against the tip of your stick (not the extreme tip, but the side of the stick close to the end), you lash it firmly by passing the twine round and round, crossing and tying it. It is the work of half a minute, and all is ready. You then plunge your phial into the water among the aquatic

plants, and allow it to fill; then pour the water so collected into one of your spare phials, and examine it with the double or triple power of your lens; going carefully over it, round and round, up and down, as you hold the phial up to the light, with your finger at the back, to make a dark background.

You will soon see if the water is at all rich; the white atoms will be dancing and whirling along in various directions. A very little practice will enable you to distinguish between their proper and voluntary movements, and such as are produced on the inanimate floating atoms by the currents of the water. The latter will be uniform, following given directions; while the former will be fitful, wayward; or if steady, yet pursued in various directions, now and then suddenly deviating, or turning on themselves.

Of the atoms which are manifestly alive, some move by little jerks, hither and thither; most of these are INFUSORIA. Others go rolling steadily along with comparative slowness; these, in general, will be ROTIFERA,—not always, because some of the higher INFUSORIA, as *Stentor*, *Bursaria*, and others, have considerable steadiness of motion. Others, again, shoot swiftly along by a succession of minute but rapid hops, which carry them to a great distance; then ceasing, they fall by their own gravity through the water: these are the Water-fleas, or *Entomostraca*, very pretty and interesting little members of the Class CRUSTACEA.

These general indications of the nature of your prey are all that you must expect in the field: they enable you to see whether your dip has been suc-

cessful or not. If, as is often the case, it swarms with INFUSORIA and ROTIFERA of many species, you cork up the phial to carry home; if not, you throw it away. In either case, you make the next dip in another place. I do not mean, that you necessarily move to another part of the pond, though that is one mode of obtaining variety; but, even without removing, you may try different conditions, and obtain varying results.

For instance, the first dip you perhaps made at the surface, collecting the very scum of the water; try the next at half-depth, and the third at the bottom, allowing a little of the sediment-mud to run in with the water. Try a dip among the Duckweed; another among the Myriophyllum; another out in the clear open water, as far from the brink as you can reach; a fourth among the grass of the margin. One on the windward side, another to leeward; one in the sun, another in the shade; and so on.

When I had filled my store of phials, and thrust in a few fragments of water-weed, I corked up the last haul in the dipping one, and, untying it, pocketed it with the rest for microscopic examination at home. I returned by a pleasant but sombre road, that winds through the plantations, with a hill on the right bristling with the dark-leaved firs and pines, and on the left a valley with a concealed stream, babbling as it goes, and thus betraying its darkling course beneath the underwood and through the trees. The sunlight played softly through the green leaves, dancing and twinkling as they quivered in the breeze, and shone upon the filmy wings of many hymenopterous and

dipterous flies that haunted the few flowers of the shaded glen. There was a pool by and by in the hollow, which was so full of the Yellow Flag, and of smaller weeds, that I could not resist the temptation of emptying one of my bottles in order to fill it here; but the result was not equal to my expectation.

At length I came to a stile leading into some corn-fields. The path through the woods had become a hedged lane; and it was miry enough, especially at this spot. I looked into the corn-fields, and saw that the footpath led along by the hedge. "Remember Christian and Hopeful, and Doubting Castle," said caution; but a ripening corn-field, with its poppies and cockles, is pleasanter walking than a muddy, clayey, watery lane; and I ventured. Fortunately, no Giant Despair seized *me*, your "special correspondent;" and at length I found myself in the Narberth Road, close to the outskirts of pretty Tenby.

XXXIII.

ROTIFERA.

How to isolate the Subject—First Mode—Result—The Yellow Philodine—Its Form—False Joints—Foot and Toes—Wheels—Spur—Eyes—Mouth—Stomach—Liver—Inversion—Eversion—Ciliary Rotations—Modes of Locomotion—Colour and Size—The Stylonychia—Its Agility—The Common Wheel-bearer—Its Manners—Addition of Carmine—Beautiful Result—Alimentary Canal—Eyes—Second Mode of Isolation—The Whip-tail—The Furcularia—Its Industry—Tube-dwellers—The Floscule—Its Body—Disk—Hairs—Internal Structure—Mode of Feeding—Manners—Tube—Eggs—Birth of Young—Size—The Melicerta—Its Claims to Attention—Tube—Unfolding of the Disk—Rotatory Cilia—Error of old Observers—Pellet-cup—Its building Instincts—A Brick-maker and Mason—Reflection of the Divine Glory—List of observed Rotifera.

August 7th.

Now I must proceed to give you some account of the microscopic treasures which I poached a day or two ago from the worshipful Mayor's preserves. First, however, a word on the manner in which the tiny game is brought under the wonder-working instrument; for, to the uninitiated, an invisible animal roaming at large might almost as well be in its native pond as in an ounce-phial. There are two or three ways of securing individual specimens, varying according to the habits of the species to be examined; and these I will deal with in turn.

The first mode is adapted for such kinds as prefer to haunt the sediment at the bottom of the phial, among which they play to and fro, and grub about for food. You will please to remember that the elegant animals known as Wheel-bearers, which constitute the Class ROTIFERA, were the particular objects of my attention; but the modes I speak of are equally applicable for the capture and examination of the INFUSORIA, the TARDIGRADA, and the minuter ENTOMOSTRACA.

I take then a tube of glass—say one-fourth of an inch in diameter—open at both ends; one extremity being drawn to a point, so that the orifice there is not more than one-sixteenth wide. Holding this between the fore and middle finger of my right hand, with my thumb firmly pressed on the upper end, I dip the tube into the phial till the pointed extremity is close to the sediment. Then I lift my thumb from the top for the smallest possible space, and instantly close it again. The consequence is that a minute quantity of water has rushed in at the lower end, carrying with it a portion of the floccose sediment, mainly consisting of decaying vegetable matter.

I now lift out the tube in the same manner as I inserted it; and, laying the point on the top of the lower glass of the live-box, remove my thumb. A drop of water and sediment oozes out; and when the live-box cover is put on, this drop is flattened out, and the box is set upon the stage of the microscope to be searched with a low power. As soon as an animal of interest is discovered, it must be watched till it become stationary (if in motion), when the low power may

be quickly exchanged for a higher; and the little creatures stand revealed in their glass-like beauty and transparency, and in all their elegant movements and interesting instincts.

One of the first objects that attracted my attention, when I examined a drop obtained after this fashion, was a fine specimen of the Yellow Philodine (*Philodina citrina*), with his wheels expanded, and rotating away as if propelled by steam.

This is an exceedingly interesting animal. (See Plate XIX.) It is of a spindle-shape—that is, thick in the middle, and tapering to each end; the lower extremity forms a sort of foot, capable of contraction by a set of telescopic sheathings, or false joints. From the lowest but one of these joints project two pointed spines; and the extremity of the foot is divided into three soft toes, which are ordinarily sheathed in that joint. By means of these toes, the foot is enabled to secure a hold of the minute stems of water-plants, or even to hold fast upon a vertical or inverted surface of glass, from which the body is elevated in a perpendicular posture, or in one variously inclined or curved. The upper parts are capable of being sheathed in a similar manner. Above a kind of neck there is a thick bulging ring, surmounted by two wheels of cilia, set side by side, the waves of which revolve with a strong rotatory motion. From the neck projects a telescopic spur or tube; supposed, but without sufficient ground, to be an organ of respiration. Just below this tube are seen two minute red specks, which are the animal's eyes; rudimentary, indeed, and probably endowed with no more of visual

power than a slight consciousness of the stimulus of light; but furnished, according to Ehrenberg, with nervous ganglions under them. Within the upper part of the body, there is seen an organ working up and down, and opening and shutting with great energy: this was formerly supposed to be the heart, but it is now known to be the mouth, or rather the enlarged head of the gullet; it is of a hemispherical form, divided through the middle, each half of which is furnished with two horny teeth placed across it; the tips of each pair meeting the tips of the opposite pair, when these singular jaws are brought into contact. The food chewed and ground by this apparatus passes into a slender canal, or tubular stomach, which is surrounded by a cushion-like mass of cells, commonly coloured with the hue of the food, and therefore concluded to be connected with the digestive system; probably serving the purpose of a liver.

The animal, as I have observed, is commonly seen attached by the foot, with the body erect, performing its ceaseless rotations. If it be touched or jarred, however, it in a moment contracts, becoming much shorter and thicker, assuming nearly an oval form, the parts sliding within each other. The wheels have quite disappeared in the same instant; the prominences on which they revolve, the bulging ring, the spur and the neck, having all been in the same moment withdrawn into the body. The process is too instantaneous to permit us to see how this is done; but the unfolding is less rapid; and we thus discern that there has been an involution of these parts. If we watch the shortened animal, however, for an instant, we

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The Yellow Philodine.

shall perceive that it is gradually projecting its head again; and presently a short, thick proboscis is seen protruding, together with the spur or tube from its side; when the former is thrust out to a certain distance, in an instant it turns, as it were, inside-out, not at the tip, but at the base, and the wheels are thus exposed as before. These are cilia set on prominences, arranged in two imperfect circles, which carry on perpetually-chasing waves; giving to the circles, especially when a little inclined towards the eye, so as to display the circle, the exact appearance of a crown-wheel rapidly revolving.

When the animal wishes to change its place, it commonly crawls along, like a caterpillar, or still more like a leech. Having drawn in the wheels, but not the whole head, it bends down the fore parts to the surface on which it is standing; then, attaching the proboscis to it by some means unascertained, it relinquishes the hold of the foot, which it then bends over, in order to take a fresh hold in the same direction; thus, it slowly proceeds by regular steps. It can, however, swim or glide with an equable motion through the free water, by the rotation of its wheels; this, however, is not quickly performed.

The specimen examined was not more than $\frac{1}{50}$th of an inch in height when fully extended, and only $\frac{1}{70}$th when rotating, as I have figured it in the Plate. It is therefore scarcely discernible by the unassisted eye; yet it may be considered as a rather large example of ROTIFERA. The whole body was of a clear transparent yellow when viewed by transmitted light, with

both the superior and inferior extremities colourless. When reflected light was brought to bear upon it, however, it became an object of great beauty. The citron-hue became positive, and brilliant, separated abruptly from the translucent portions; while the whole animal took a most sparkling appearance, reflecting the rays of light from various points of its surface, as if it had been carved out of a precious stone.

Plate XIX. represents a specimen of *Philodina citrina* greatly magnified, fully expanded and rotating, and viewed so as to expose the dorsal aspect.

The water was thickly tenanted by an excessively nimble and restless little creature, one of the INFUSORIA, of the genus *Stylonychia*. It is covered by an oval glassy plate, like the back of a Tortoise, convex above and concave beneath; and this latter surface is beset with many stout pointed spines, some of which are curved, and others straight. These animals, which were excessively numerous, darted about very irregularly, with a bobbing motion; rarely going far in one direction, but shooting a short distance, and then instantly receding, turning short round, and starting hither and thither so fitfully, that it was difficult to get a fair sight of their form or structure. The margin, and also an oblique slit which represents the mouth, are fringed with cilia. On the vibration of these depends the darting motions; but the funny little creature creeps, like a mouse, along the stems of *Conferva*, and

over the atoms of floccose matter, by means of its curved spines, which it uses as feet, with great rapidity.

While I was amusing myself with these, I observed a specimen of the Common Wheel-bearer (*Rotifer vulgaris*) rear up his long and slender form, and presently throw out his double wheel, and commence his rapid gyrations. This belongs to the same family as the Philodine; the principal technical distinction being the position of the crimson eye-specks. He was very active, very impatient of being touched; and as the *Stylonychiæ* were every moment intruding upon him, he was continually contracting and extending; no sooner having his wheels fairly set a-going, than in an instant he had to furl them, take in his lofty gear, and put all snug under hatches. I will do him the justice, however, to say, that he was as rapid in opening as in closing his apparatus; and that with a perseverance that all the rude assaults of his neighbours could not wear out. Presently another of the same species threw himself across the former; and thus I had two specimens within reach of the smoke from each other's funnels. Both were somewhat vagrant; for though they cannot display their gyratory motions to advantage except they cast anchor, by means of the cleft extremity of the foot, yet they frequently change their place; and this my specimens performed with so much rapidity as to employ all my skill to keep them within the field of view, or to follow them up, when they had slipped out before I could move the stage. As they were alike, I shall speak of but one. When moved, he

would throw himself in all directions, his foot being the centre of a circle which his head described, his wheels going all the time vigorously: all on a sudden he would stretch himself out laterally, bend down his head, then, letting go his hold, draw up his foot by a rapid contraction of his body, take a fresh hold, again stretch out and draw up his foot, very much like a worm, making headway very fast; or sometimes he would let go with his foot, and shoot away in a straight line through the free water, with a gliding motion; and I had to search for him in a distant part of the live-box;—no easy operation.

A little carmine having been added to the drop under examination, I proceeded to watch the result. It was not many minutes in disseminating, which was aided doubtless by the ciliary action of this and the other numerous animalcules in the drop. As the particles of carmine approached and involved the *Rotifer*, they produced a most charming spectacle. Their opacity and number rendered very perceptible the currents caused by the ciliary wheels, as they were whirled, in swift circles or vortices, about the creature's head; both streams being carried to a point in front of the centre of the head, where there is a notch in the outline. Here the particles of both currents met; and, being accumulated as in a funnel, poured out in a dense and continuous stream, which diffused itself, at some distance, through the surrounding fluid, to be again drawn into the vortex of the wheels. This was a beautiful and astonishing sight; and I can compare the appearance to nothing else than the stream of dense smoke that pours out from

the funnel of a steamer, and lies along the air in an undulating line of varying thickness,—only imagining the smoke to be deep crimson instead of murky black.

Some of the carmine was swallowed; and, after a little while, its presence was manifest within the body; rendering very distinct the alimentary canal, which, like a crimson thread, commencing just below the jaws, terminated in an oval sac at the base of the foot. Its course was slightly tortuous; and the crimson contents were not visible in immediate contact with the jaw-head, nor did it extend quite to the stomach-sac, though the latter was full of the pigment. The canal is surrounded by a thick cellular mass, of a yellowish tinge, and perfectly transparent. The jaws resemble those of *Philodina*, and, like them, work vigorously, opening and shutting; not, however, equally, but opening at the lower extremity, while the upper edges remain nearly in contact. On a rounded proboscis, just below the indented outlet for the ciliary currents, are situated two minute red eyes.

The mode in which the wheels are expanded is the same as in *Philodina*. A sort of truncated proboscis, on which the eyes are situated, is thrust out more and more, until in a moment it seems to be turned inside-out, and the wheels are expanded and working energetically. This sight always surprises and delights; the suddenness of the evolution, the rapidity with which it is completed, the instant change in the water produced by the whirling, and the contrast made by the broad wheels to the narrow case in which they were enclosed—all strike the mind, even after it has been many times witnessed.

A second mode of examination is to cut off a few of the filaments of some water-plant; and, putting them into the live-box, not too densely, search them with a low power for such animals as are stationary on them, or such as make them their hunting-ground.

Of the latter sort is the elegant Whip-tail (*Mastigocerca carinata*), one of the most exquisite of the ROTIFERA, which sways to and fro on the point of its long spine-like foot; displaying its long-oval body of crystalline clearness, and its curious dorsal crest or fin. So, too, is the little *Furcularia gibba*, that grubs up and down the stems of *Conferva* and other plants; quartering the ground with great regularity and perseverance, rooting all the while with its indefatigable muzzle in the floccose sediment that accumulates there. Plenty of prey it secures in this way; its jaws are perpetually nibbling; and we discern from time to time, through its transparent integuments, the evidences of its feast, in the empty shells of *Naviculæ* and other Diatoms, that it has swallowed, and that lie in its distended viscera.

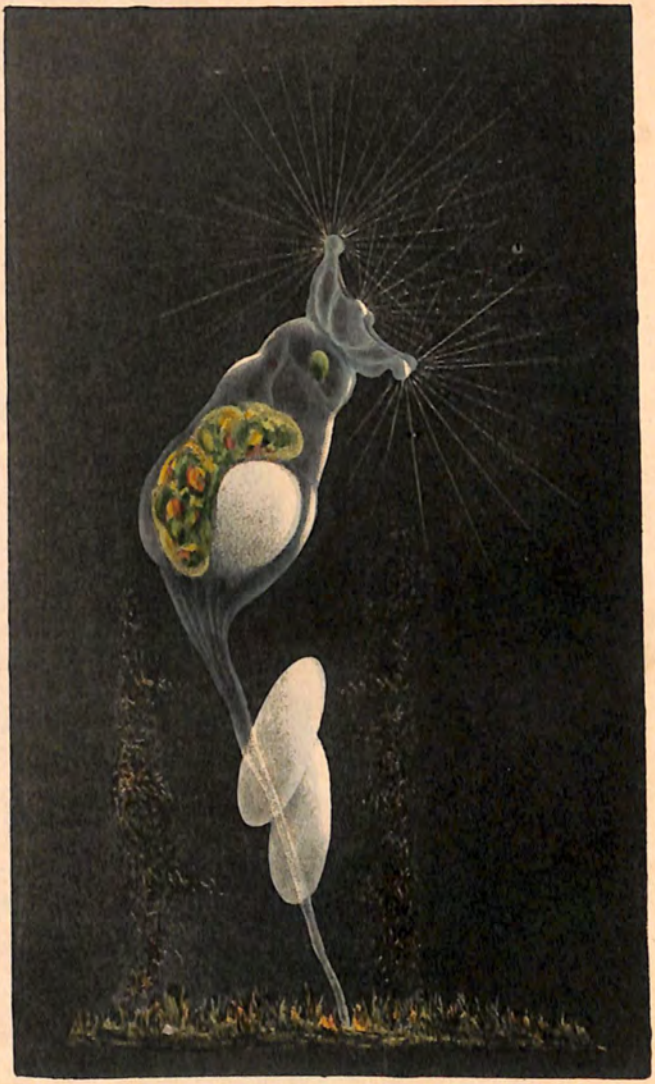
But perhaps more interesting, because more subject, from their fixity, to our full and leisurely examination, are those that are attached to the plants. I refer to the Tubicolous ROTIFERA, which inhabit a cylindrical case, or tube formed by themselves, attached by its lower end to the stem, and open at the summit; from which the animal protrudes, when it would exercise its active instincts, and into which it retires for repose from labour, or for refuge from alarm.

Of this sort I found a notable example in the

Beautiful Floscule (*Floscularia ornata*), which I have represented in Plate XX.

This also must be ranked among the most elegant forms of the Class. I find it adhering to the fingers of the *Myriophyllum* in some numbers. Within a cylindrical tube, so filmy that it is with the utmost difficulty that it can be detected, is ensconced this beautiful creature. When contracted, the body is oval, tapering to a muscular, but colourless foot, shrunken into numerous close-set annular wrinkles, whereby its substance is thickened, displaying many longitudinal muscles through its length, by which it is extended. From the summit of the head, where the margins of an orifice are drawn together, forming a puckered end, arises perpendicularly a thick pencil of very fine long hairs: when quite contracted, this brush is cylindrical in form; but as the animal protrudes, the pencil gradually becomes divergent, until the orifice bursts open and discovers its real character. The mouth is now seen to be expanded into a broad membranous flower-like cup, with five pointed wings or petals, the end of each being surmounted with a rounded knob. From this knob proceed the hairs, which are very numerous, exceedingly slender, and diverging in the most elegant manner in form of a star; the central rays being long, and diminishing in length on each side. When the pencil of united tufts is in the process of expansion, the hairs have a wavy, quivering sort of motion; but when expanded, they remain perfectly motionless. Ehrenberg does not seem to have understood this animal: this is not a rotatory organ; yet there is a rotation; the parti-

cles of floating matter revolving in a perpendicular oval, within the mouth of the disk. Hence, I conclude that the rotatory cilia are set on the inner surface of the disk. The whole body appears lined with a yellowish vascular membrane, which does not extend up to the petals, but terminates at the neck with a free, very mobile edge, forming an irregular opening, the outline of which is constantly changing by the contraction and expansion of the membrane. The opacity of this lining renders it difficult to resolve the viscera; but we sometimes discern, situated near the middle of the body, a pair of jaws of two teeth each, much resembling the claws of a crab. These cause their points to approach and recede with considerable constancy; occasionally resting. These organs are placed in the midst of a great stomachal sac, commonly filled with a yellow-brown or green mass of digesting food; and below this is another sac,—the intestinal canal. Ehrenberg speaks of an œsophageal head above the jaws; but I can see nothing of the kind; and incline to think he may have mistaken the ever-contracting opening of the lining membrane for one. Carmine and indigo diffused in the water were not taken into the body; but I saw a Monad whirled down the centre of the mouth by the ciliary vortex, glide through the orifice of the membranous lining, and pass obliquely across to the jaws, which worked upon it for a few seconds, after which it passed down into the lower part of the stomach. Seeing this, I put to it a drop of water containing several Monads; three or four were soon engulphed, whirling in the vortex, but none were swal-



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The Beautiful Floscule

lowed, nor passed the membrane; but this seemed to reject them, pushing up two lips when they touched it: at length, by a sudden contraction, the animal drew itself forcibly away from them, leaving the Monads far above; after which it remained for some time closed. The foot is very long when extended, reaching almost to the mouth of the tube; the swelling near its base is not always apparent, sometimes merging into the body. The hyaline disk, when expanding, appears circular, and the knobbed points are pushed forth from within its edge by a partial inversion.

The manners of this individual were by no means sluggish: it was sensitive to alarm, retracting itself often with sudden force, not only on any jar or shock, but apparently without any cause, except perhaps the contact of some minute bodies in the water. But no sooner was it contracted, than it instantly began again to extend, protruding its flower-like disk without delay; nor was it more slow in this than the generality of ROTIFERA. The motions of the jaws, and the contractions of the membranous lining (and of the walls of the body, especially of the neck, correspondently), were also continued with considerable constancy.

The enveloping tube is so hyaline, that unless one looked for it, it would certainly not be seen, even with the closest scrutiny, and the most careful adjustment of light and focus; its refractive power is so nearly that of water, that the outline can only now and then be caught as an evanescent line. By the admixture of indigo, however, it becomes more mani-

fest; only as an oblong parallelogram, clear of colour, however, without any distinct outline. There is evidently no organic connexion between it and the inhabitant. It is a thick gelatinous excretion from the body, thrown off in successive rings; and hence the lower parts are the more dense, the summit or edge being so attenuated as to melt imperceptibly off into the surrounding water. In old specimens the tube is sometimes more distinct, owing to the entanglement of floccose atoms, small Diatoms, and other floating matters, in its viscid surface.

In other individuals, the functions of reproduction were active. The ovary is a large clear organ, filling the ventral portion of the visceral cavity, and forcing the digestive organs backward, as it develops the ova. These at first appear as clear spherules, each with a nucleus; but they successively mature into soft white eggs of comparatively large size, and are discharged one by one into the tube. They are now of a determinate figure, each being enclosed in a long-oval calcareous shell, like those of a bird. Sometimes as many as nine may be seen within the tube at once.

After several hours, the egg-shell bursts, and the infant Floscule makes its appearance. It is a white cylindrical maggot, blunt at the front end, with a central orifice, whence protrudes a short brush of cilia; but the margins are capable of unfolding, when the cilia are seen to form a whorl around the truncate summit, swiftly rotating. The margin soon begins to bud forth the little knobs, around which the cilia are gathered; these quickly increase

in length, and the angular flower-like disk gradually forms. Meanwhile, the little creature, which was at first free, attaches itself by its hinder end, and assumes the conditions, as well as the form, of the parent. The tube, however, is not discernible till adult age; though, doubtless, it begins to be excreted early.

Two red eyes are visible in the back part of the neck in the young animal: these ordinarily disappear in the adult; but I have occasionally met with specimens, apparently of full age, in which they were still plainly visible. In the specimen which I have represented, they came out with beautiful brilliancy under reflected light,—the best test of the presence of these organs.

The beautiful Floscule is ordinarily about $\frac{1}{70}$th of an inch in height; but I have seen individuals which were twice as high as this. I do not include the hairs of the disk in the measurement, but these are of great length; I have traced them to the extent of $\frac{1}{83}$d of an inch, without any certainty of their terminating there.

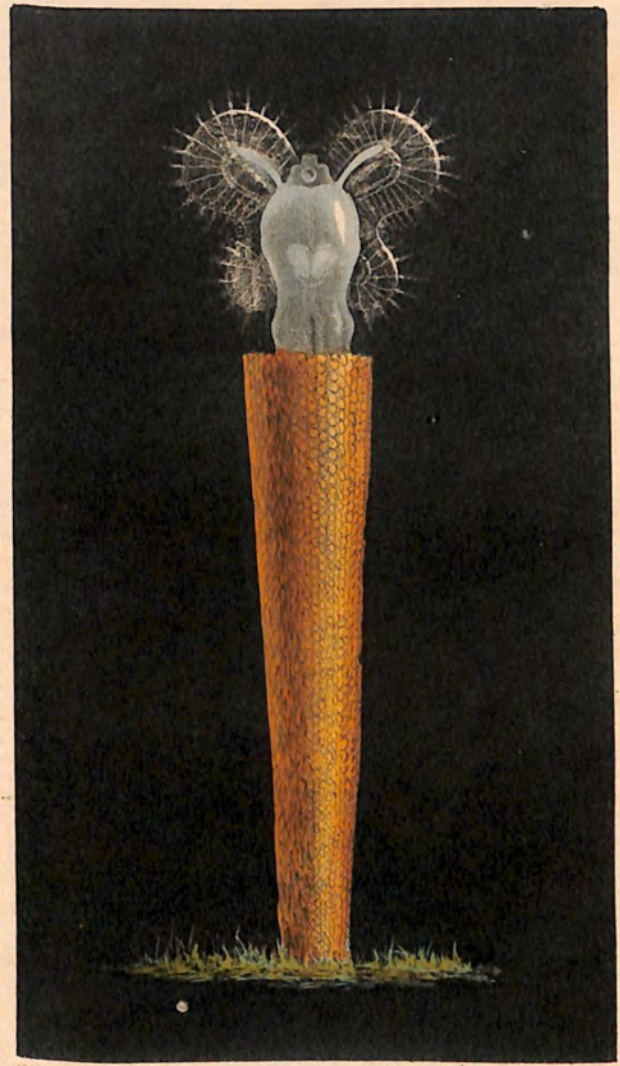
Plate XX. represents *Floscularia ornata*, viewed as an opaque object by reflected light, and magnified 220 diameters. It is seen in lateral aspect, with the disk expanded, in the act of swallowing a Monad. The red eye is seen in the nape, just below the level of the vascular membrane; the stomach and intestine, filled with green and yellow animalcules, is shown behind, and the ovary is occupied by a large

white ovum maturing. Two eggs are already deposited, and are seen in the interior of the translucent tube, adhering to the foot.

Nor was the Floscule the only example of a Tubicolous Wheel-bearer that I found on this prolific weed. Some of the segments of the much-divided leaves were studded with the dark and conspicuous tubes of *Melicerta ringens*. This animalcule, though still minute, is considerably larger than the preceding; since the cases are distinctly visible to the unassisted eye, their opacity aiding their detection.

Interesting as being one of the first ROTIFERA ever observed, if not the very first (since it was described by Leeuwenhoek as early as 1703), it is still more attractive because of its curious faculties, rivalling in its architectural instincts the beaver and the bee. In one respect, indeed, the *Melicerta* excels these industrious animals, since he actually manufactures the materials with which he works. He is a mason, who not only builds up his mansion, brick by brick, but makes his bricks as he goes on, from substances which he collects around him, shaping them in a mould which he carries upon his body.

Let me describe his person first, and then his operations. Imagine, then, a little tube about $\frac{1}{30}$th of an inch high, slightly widening to the top. It stands up from the surface of the leaf, erect, being affixed by the base, which is sometimes dilated; the mouth being uppermost. This tube is of a dark yellowish or reddish-brown hue, and is found to be



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The Melicerta

composed of a multitude of round pellets, set very regularly in a sort of mosaic, apparently agglutinated by a cement insoluble in water.

But, while we gaze, a curious object is slowly protruding from this tube. A complicated mass of transparent flesh appears, involved in many folds, displaying at one side a pair of hooked spines, and at the other two slender truncate processes projecting horizontally. As it exposes itself more and more, suddenly two large rounded disks are expanded, around which at the same instant a wreath of cilia is seen performing its surprising motions. Often the animal contents itself with this degree of exposure; but sometimes it protrudes farther, and displays two other smaller leaflets opposite to the former, but in the same plane, margined with cilia in like manner. The appearance is now not unlike that of a flower of four unequal petals; from which resemblance, Linnæus, who compared it to a ringent labiate corolla, gave it the trivial name *ringens*, by which it is still known. On each petal we see a white line, probably a nervous thread, running parallel with the margin, to which many short lines radiate from it. (See Plate XXI.)

But the eye is involuntarily drawn from the petals themselves of this living flower to the beauty of the coursing cilia: these appear to chase each other in ceaseless race along the margin, running down and up the sinuous divisions of the petals; now relaxing, now refreshing, their speed. This progression of the ciliary waves is now well understood; but while we gaze upon them, we find it easy to forgive the error

of Colombo and Dutrochet, who maintained that the teeth actually ran around the margin of the stationary wheel.

Below the large petals, on the ventral aspect, and just above the level of the projecting antennæ, is a small circular disk or cavity, within the margin of which a rapid rotation goes on. This little organ I can compare to nothing so well as to one of those circular ventilators which we sometimes see in one of the upper panes of a kitchen-window, running round and round, for the cure of smoky chimneys.

It was not on the present occasion that I first observed the manner in which the *Melicerta* constructs its tube. Nearly five years ago I witnessed this operation, and discovered its connexion with the singular little ciliated cavity below the petals. The observations then made I published in the Transactions of the Microscopical Society, from which I now abridge them.

When fully expanded, the head is bent back at a right angle to the body, so that the disk is placed nearly perpendicularly, instead of horizontally; the larger petals, which are the frontal ones, being above the smaller pair. Now, below the larger petals (that is, on the ventral side) there is a projecting angular chin, which is ciliated; and immediately below this is the little cup-like organ in question. It appears to form a small hemispherical cavity, and is capable of some degree of projection, as if on a short pedicle. On my mixing carmine with the water, the course of the ciliary current was readily traced, and formed a fine spectacle. The particles

are hurled round the margin of the disk until they pass off in front through the great sinus between the larger petals. If the pigment be abundant, the cloudy torrent for the most part rushes off, and prevents our seeing what takes place; but if the atoms be few, we see them swiftly glide along the facial surface, following the irregularities of outline with beautiful precision, dash round the projecting chin like a fleet of boats doubling a bold headland, and lodge themselves one after another in the little cup-like receptacle beneath. The action of the cilia which perform this transport is clearly seen; and I believe that they are continuous from the great sinus to the cup. The contents of the cup are whirled round with great rapidity; and it was while looking at this spectacle, that the notion occurred to me that the pellets of the case might be prepared in this receptacle.

I now watched the animal with eager expectation, and presently had the satisfaction of seeing it bend forward its head, as I had expected; and, after a second or two, raise it again; when I saw that the little cup had lost its contents. It immediately began to fill again; and when it was full, and the contents were consolidated by rotation, aided probably by the admixture of a salivary secretion, it was again bent down to the margin of the case, and emptied of its pellet. This process I saw repeated many times in succession, until a goodly array of dark-red pellets were laid upon the yellowish brown ones; but very irregularly. After a certain number were deposited in one part, the animal would suddenly turn itself round in its case, and deposit some in another part.

It took from two and a half to three and a half minutes to make and deposit a pellet. Some of the atoms of the floating carmine now and then passed down the œsophagus into the gizzard, and thence into the stomach; but these were quite independent of, and unconnected with, the pellets, which were composed exclusively out of the torrent that had passed off the disk. On one occasion the cup was brought down to the margin, but, from some cause or other, failed to deposit its pellet: it was raised for a moment, and then a second attempt was made, which was successful.

If the possession of powers and faculties corresponding to those which in us are the result of reason acting on experience, and producing contrivance and forethought, surprise us so much in the brute creation, and exalt our ideas of the wisdom of the great Architect, how much are these feelings enhanced when we find such endowments bestowed on an organism whose whole body is not larger than the dot which puts a period to this sentence. Surely the soul which animates this atom is even a more wonderful example of Divine power than the inanimate mass of the planet Jupiter.

Plate XXI. represents the *Melicerta*, as seen by reflected light, showing the ventral aspect, magnified 110 diameters.

It may not be uninteresting that I should enumerate the species of ROTIFERA that I have recognised

in this vicinity, with the localities from which I have obtained them.

From the Sea.

1. Synchæta Baltica.

From Knightston Pond.

2. Philodina citrina.
3. Rotifer vulgaris.
4. Floscularia ornata.
5. Melicerta ringens.

From a Pool on the road to Knightston.

6. Synchæta mordax.
7. Euchlanis deflexa.
8. Anuræa aculeata.

From Scotsborough Pond.

9. Notommata aurita.
10. Noteus quadricornis.

From the Marsh near Holloway Bridge.

11. Furcularia gibba.
12. Notommata gibba.
13. Mastigocerca carinata.
14. Monocerca porcellus (?)
15. ——— bicornis.
16. Euchlanis hipposideros.
17. Chætonotus maximus.

From the Marsh near the Abattoir.

18. Brachionus Bakeri.
19. Anuræa squamula.

From holes in the Bog, whence ball-clay is dug.

20. Floscularia cornuta.
21. Notommata najas.
22. Salpina ventralis.
23. Euchlanis luna.
24. Metopidia lepadella.
25. Anuræa stipitata.
26. Pterodina patina.

From a Pond in Haywood Lane.

27. Chætonotus larus.
28. Salpina bicarinata.

XXXIV.

SPONGES.

The Rose-coloured Sponge—Its Form—Spicula—Investing Membrane—Ex-current—Projectile Tubes—The Scarlet Sponge—Its Phenomena—Evidences of Animal Life—Enumeration of Species—Crumb of Bread Sponge—Caruncled Sponge—Crust Sponge—Scarlet Sponge—Soft Scarlet Sponge—Rose Sponge—Sack Sponge—Crowned Sponge—Cluster Sponge—Rigid Sack Sponge—A Caveat.

August 8th.

In the narrow Cavern that I have before named No. 1, if we enter from the north, striding across the first deep pool by the aid of the rocky sides, we come to a shallower pool beneath the overhanging wall, on the right hand. In this I found several specimens of an interesting Sponge, which my friend Mrs. Brett informs me was until lately unknown; she having sent specimens to Mr. Bowerbank, who proposes for it the specific name *rosea*. It is, however, somewhat variable in colour; for some of my specimens are of a fine red-purple hue, others are lilac, and others nearly white. In form it bears a close resemblance to *H. panicea*, being an incrusting species, spreading over the rock, and rising into well-marked mamillary eminences, each of which is perforated with a large circular

orifice. The substance is spongy; and the surface under a lens is seen to bristle with numerous perpendicular points, which, with a higher power, are discovered to be acicular spicula, projecting irregularly in small groups. To these adhere a pellucid, colourless, gelatinous membrane, which appears to invest the whole Sponge; the spicula piercing through it, and carrying it partially with them, so that it hangs in crescentic veils from group to group.

But what struck me particularly was the relation which this investment seemed to bear to the excurrent orifices. When the Sponge was newly gathered and placed in a trough of sea-water, a strong intestine motion of the fluid was presently visible with the naked eye; and this, with a lens, I could readily trace to a powerful and constant ejection from the mamillary orifices. It was, in fact, far more forcible than in any other Sponge which I had before seen. I placed it on the stage of the microscope, having previously mingled a little carmine with the water, and was pleased to see how the water, loaded with the atoms of pigment, was uniformly drawn from all surrounding parts; how it rolled up the sides of the hill, and then how it was shot away perpendicularly, like a torrent of ashes from the crater of a vomiting volcano.

After I had watched this process awhile, I removed the Sponge from the contracted limits of the stage-trough, and replaced it in a jar of fresh sea-water in my study-window. In a short time I perceived a membranous tube, excessively delicate and pellucid, projecting from the interior of the mamillary aperture

(there was but a single perfect mamilla on this specimen), to the height of about a line. Its shape was semi-elliptical, for the extremity was contracted to a circular orifice, about half the diameter of the tube. This appeared to be only a continuation of the common gelatinous investiture of the Sponge, and bore a few of the acicular spicula imbedded in its substance, especially towards its base, yet not so thickly as to materially interfere with its translucency. It was not sensitive, for it did not shrink when touched under water; but, on being removed from the vessel, the tube shrivelled away so as to be invisible when again examined, though only a second or two had elapsed. It appeared again, however, in a few minutes; but was very small at first, and closed at the extremity, by the contraction of the sides.

A phenomenon, quite similar to this, I have observed in some other Sponges. A specimen of *Halichondria sanguinea*, which I have kept for some months in a marine tank, has the property of pouting out a clear colourless membrane of exceeding delicacy.

When carefully watched under a power of 70 diameters, this brilliant species exhibits the following appearances. At first we discern an uneven surface, with little eminences here and there, like hills in an undulating country. A great number of very slender glassy rods (*spicula*) project at various angles from the surface, perfectly straight, equal in thickness in every part, with blunt tips. Webs of the investing membrane cling around the bases of these rods, and are a little elevated with them.

Presently from one and another of the hillocks a round bladder is seen pushing out, which gradually lengthens, until it becomes elliptical. It is composed of a clear gelatinous membrane, excessively subtile, with a yellowish granular film spread irregularly over its surface. Orifices are now perceived in the rounded tip of the bladder; the formation and increase of which are so very gradual as to defy detection, except by the result. There may be from two to half-a-dozen of these openings, differing in size, and quite irregular in position, with relation to each other, but all near the extremity of the bladder. They have invariably a well-defined outline, which is always rounded in every part, except where two contiguous ones are divided by a slender thread of the common membrane, in which case the two form the halves of a circular or ovate figure. These orifices slowly alter, increasing or diminishing; sometimes a minute one appears at the margin of a large one, augmenting at the expense of the latter, until the dividing film stretches across,—a narrow straight isthmus between two lakes of equal dimensions. Sometimes the whole bladder wrinkles, and partially collapses into a rugose column, and then slowly distends again, when the openings are seen as they were before. The appearance of the clear *plasma*, and the changes of the orifices, resemble closely the "sarcode" or gelatinous flesh of th *Amœba*, and the constant changes of figure whic that Protean Infusory undergoes; only that here the process of alteration is more imperceptible.

The efferent stream pours out at each of these orifices, carrying with it fœcal matters from the

interior, and any light floating atoms that may be in the vicinity; as I saw with beautiful distinctness, by making the surrounding water slightly turbid.

On my touching the bladder with the point of a needle, it at once shrank up into a wrinkled column, but did not retract, and presently distended again. Thus, the common statement that in the Sponges "contact, however rude, excites no movement or contraction, which might indicate its being perceived," * was not in this case verified. On the contrary, the specimen exhibited very distinctly those characteristics of animal life,—sensibility to touch, and spontaneous movements.

On my examining the same specimen, after some four or five days, during which it had been kept in a small Aquarium, free from all disturbance, I found the protruding bladders very much more developed. They now formed cylindrical erect tubes no thicker than a hog's bristle, but from $\frac{1}{12}$th to $\frac{1}{8}$th of an inch in height, with a single orifice at the extremity, whence a strong current was issuing. Hence I infer that the numerous small round openings gradually become fused into one, and that the protrusion of the oval membrane varies in degree according to the state of disturbance or repose to which the Sponge is subject.

As the Sponges are particularly abundant in the caverns, and on the rocks of the north side of the Island, perhaps you will not think it out of place if I just enumerate such as I have observed; mentioning

* Jones' Anim. Kingd.; 12.

the more obvious characters by which they may be recognised and distinguished.

1. Perhaps the most common is *Halichondria panicea*, the Crumb-of-bread Sponge. This is of a dull brownish yellow, woolly in texture, spreading over the surface of the rocks, in patches of no definite shape or dimensions; some specimens measuring less than an inch, others five or six inches, in diameter. It rises into little conical hillocks, about half an inch apart, on an average: these are from one-eighth to one-sixth of an inch in height, and commonly one-fourth in diameter at their base; but they merge so gradually into the separating valleys, that they cannot be individually defined. Every hillock is terminated by an orifice, about a line in diameter, which is the mouth of a discharging canal; and through these mouths, when the Sponge is in healthy action, currents of water are poured forth, as I have just described. No visible current passes inward; but as the outgoing stream is continuous, at least for lengthened periods, it is manifest that the water must pass into the interior in quantity correspondent with it. It doubtless enters through the innumerable minute pores which stud every part of the surface; thus permeating the whole substance. When it has parted with its oxygen, and thus revivified the living gelatinous flesh that clothes every fibre, it gradually gathers into canals, which unite into larger channels, and at length vomit forth their streams from the elevated mouths of the little hillocks: just as the rains and dews, falling noiselessly and unobtrusively over a great extent of country, collect in mountain springs, which

feed the rivulets and brooks, and these in their turn unite into rivers, which open on the coast in broad estuaries, and send forth a volume of fresh water, whose influence extends for miles or leagues into the ocean.

2. Nearly, if not quite as abundant as the preceding, at least in this locality (for it seems to be a local species), is a kind which has not yet been described. Mr. Bowerbank, however, has seen it, and proposes, as I am informed, to designate it by the name of *H. caruncula*. In general appearance it is somewhat like the former, but it rises into sharp irregular ridges, and is of a bright orange colour, which arrests the eye at once. It is, therefore, very conspicuous.

3. *H. incrustans* is also a spreading Sponge, of a light orange colour. It grows in large plump masses, spongy in texture, soft to the touch; it is rough on the surface, but not ridgy, like *H. caruncula*, and is altogether much more attractive.

4. *H. sanguinea* forms irregular patches of a rich vermilion hue; its surface is slimy, almost without eminences, and the substance is usually so thin that, on applying the finger-nail to it, it feels quite hard, because so slight a medium intervenes between the finger and the supporting rock.

5. *H. seriata* is also a scarlet Sponge; this grows in plump rounded masses. At first sight it is much like *H. sanguinea;* but it is sensibly soft to the touch, and the orifices are more regular and more conspicuous.

6. *H. rosea* I have described above. It is rather rare, even here, and unknown elsewhere. Its rose-

red or purple colour will in general suffice for its recognition.

7. *Grantia compressa*, the Sack Sponge, as I have before described, forms little white bags, flattened together, from half an inch to an inch or upwards in diameter, with one or more orifices seated on angular prominences of the flattened edge. It more commonly grows on the stems of Sea-weeds than on the rocks.

8. *G. ciliata*, the Crowned Sponge. This forms oval, or elliptical bags, of whitish hue, very shaggy in texture, each with a terminal orifice, which is encircled by a series of long needle-like spines of glassy substance, projecting nearly perpendicularly, but slightly diverging.

9. *G. botryoides*, the Cluster Sponge, consists of many irregular tubes of compact, but brittle white substance, aggregated together.

10. Besides these, there is another species of *Grantia*, as yet undescribed; very much like the Sack Sponge, but differing from it in being rigid; whereas that is soft, flaccid, and tough.

I am aware that the characters which I have assigned above to the various species, do not in all cases agree with those given by the late lamented Dr. Johnston, in his "History of British Sponges." I have, however, described them as I see them; trusting I have not mistaken the species. I ought to add that my observations are confined exclusively to the specimens actually growing on St. Catherine's Island. This is important to be remembered, because the same species is often found to be greatly modified in form,

colour, and other characters, by the varying circumstances and conditions of remote localities. I have, moreover, restricted myself to such obvious external distinctions of form and colour, &c., as may be determined without microscopical examination; which, however, is indispensable to a critical diagnosis of species, and even of genera, in this Class.

XXXV.

THE BOWERBANKIA, &c.

August Tides—North Coast of St. Catherine's—Mud—Desmarestia—Fourth Cavern—Bowerbankia—Varieties of Habit—Development—Process of Protrusion—The Polype—Bundle of Setæ—Tentacle-Bell—Beauty under reflected Light—The Purple Sabella—Its Tube—Crown—Tubercles.

August 9th.

THE full-moon tides of this month have receded much farther than those of July, leaving great tracts exposed, which I have not before been able to explore. We can now walk with unwetted feet into the sandy cove on the south side of St. Catherine's, and also into that rocky one on the north side; both of which I have already described. To-day I accompanied a friend (to whose scientific acquirements and kindly courtesy I have been greatly indebted) on a walk round the points of the northern side of the Island. It was indeed no small exploit for a lady; for the whole shore exposed at the foot of these rocks is covered with a thick coat of impalpable mud—the pulverulent débris abraded from the limestone by the action of the sea; and through this we had to wade, to the infinite defilement of our garments. However, in one muddy pool, we found a noble specimen of

Desmarestia ligulata, a fine Sea-weed, very much resembling a Fern in form—a resemblance which is enhanced by its membranous texture, and its olive-green hue.

I found a fourth perforated Cavern, very far out, and not a great way, I should think, from the extremity of the Island. It was, however, long, and gloomy, very narrow, the walls just wide enough apart to allow a person to advance. The way is difficult, because it is necessary to climb over angular masses of rock rough and high, which lie in confusion along the whole floor of the passage. We cannot look through it, because the direction, near the middle, takes a sudden bend; so that, to that point, we grope on in increasing darkness. At length, however, I saw light before me, reflected from the walls near the open extremity; when I returned, having satisfied myself of the penetrability of the passage.

The pleasure of the exploration was, however, all of interest that I had in return for my labour; for though I expected to find a good deal worth seeing in the zoological and botanical treasures of so inaccessible a spot, I found it almost quite barren, and absolutely devoid of any object which, either from novelty or variety, possessed the slightest interest.

Thus I found, as I have often done before in my Natural History experience, that it is not always the most "likely" places that yield the richest harvest to the explorer.

On the other hand, places that you think you have quite searched over and exhausted, will often produce something or other new, or at least interesting,

which you wonder that you could have overlooked before. Thus I found, on the present occasion, material for pleasant investigation in a spot that is open to examination at almost every tide.

For, on the sides of the rocks at the northern end of the third Cavern, I found *Bowerbankia imbricata* in great abundance, and in unusually fine development. Sometimes it grows in dense shrubby tufts two inches in height, hanging down from the rock when the tide has left it dry, having the cells densely crowded on all sides of the flaccid stems, without any tendency to that "aggregation on one side, leaving the opposite side of the branch nearly bare,"—that Dr. Johnston speaks of.

More commonly, however, it is found in dense clusters on small Algæ; and especially on the Common Coralline, on the stony branches of which its root-thread creeps irregularly about, here and there throwing out crowded groups of its elegant pellucid cells. (See Plate XXII.)

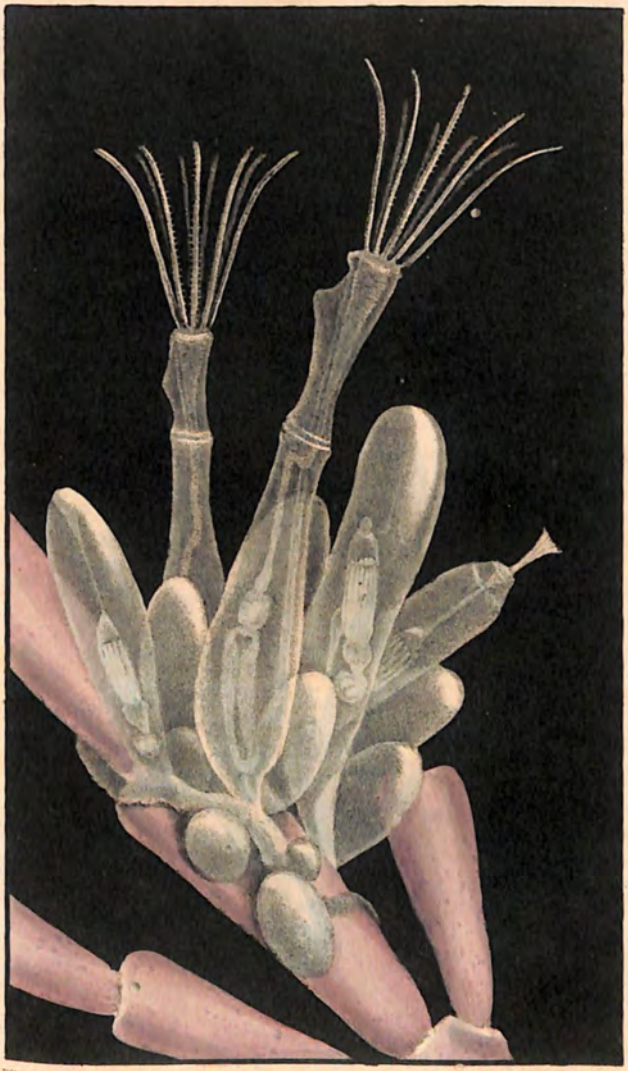
In such a cluster, specimens of the animal may be seen in almost every stage of its growth. Here there is a minute pellucid globule seated on the side of the root-thread, from which it is budding, looking like a little grape. Others are lengthening, first to an oval, then to an elliptical form, more or less produced. Others have attained their full size of about $\frac{1}{10}$th of an inch long, and their adult form of a long cylinder, but with the extremity rounded and hermetically sealed; for as yet the inhabiting polype is not sufficiently advanced to communicate with the external world, though its immature form and bundle of short

dumpy tentacles may be discerned within its clear prison. Others, again, have attained their complete development, and may be observed in different stages of expansion or contraction.

By watching the process of protrusion, we perceive that the little animal does not differ materially in structure from other POLYZOA; from the Sea-mats, for instance, or from the Stag's-horn. In the former case, the cells are calcareous, rigid, and arranged in regular order; here they are membranous, soft, free, and irregularly clustered. The cells are membranous in the Stag's-horn, but they are imbedded in a common gelatinous flesh, and concealed except when the polype is protruded; here, as I have said, they spring from a creeping thread, and are erect and unconnected with each other, though crowded.

The expansion or protrusion of the polype is a process of eversion, as when a stocking is drawn off the foot. When the proper muscles are made to contract, the membranous edges of the cell are seen to turn themselves inside-out, lengthening the cell gradually at its upper extremity. At a certain stage, a bundle of stiff straight rods (or *setæ*) emerge from the orifice, the tips of which slightly separate when their evolution is complete.

As the process goes on, the tips of the tentacles are seen pushing up from the centre of the fascia of *setæ;* the latter expanding to permit the exit, and, when the tentacles are fully extruded, standing perpendicularly around their base, so closely as to be indistinguishable. The tentacles are not turned inside-out, but simply pushed upward; the point at which



P.H.Gosse del et lith. Vincent Brooks Imp.

The Bowerbankia.

the inversion begins being below their base. When fully extended, they open into a bell- or goblet-form, and are seen to be ten in number, ciliated in the usual manner.

In this condition the height of the polype is at least double that of the cell, and it is, distinctly visible with the naked eye. It forms a very interesting object when viewed by means of transmitted light; its transparent integuments permitting every part of its internal structure to be clearly discerned. But when reflected light is employed, the beauty of the spectacle is greatly increased. The whole of the cells and of the polypes appears as if blown of clear glass, the surfaces of which reflect the light with great brilliance. This brilliance is yet further enhanced, if, by delicate manipulation, and adjustment of the mirror of the microscope, the rays from the lamp are made to illuminate the object, while yet not a single ray is allowed to proceed by direct reflection from the mirror to the eye. The polypes are then seen projected on a perfectly dark background, while every line shines out with vivid brightness; the edges of the cells, of the polype, of the internal viscera, and of every individual tentacle, having the refulgence of polished silver. Such a sight is worthy of admiration, even by an experienced microscopist.

Plate XXII. represents a cluster of *Bowerbankia imbricata* growing parasitically on a branch of *Corallina officinalis*, and magnified 25 diameters.

In a dark basin high up in the same corner I discovered, what is always a beautiful object, the

blossom-like crown of one of the larger *Sabellæ*, finely expanded. I easily detached the tube, which, like those of most species of this genus, is formed of an impalpable mud, deposited on a membranous lining, and about as large as the stem of a tobacco-pipe. The mud, however, in this species forms a much less important component of the tube than usual. It proved to be *Sabella bombyx.*

In a vase it expanded well and readily; but at first it lolled out of its tube to such a degree that I feared it was going to give me the slip. The crown of gill-filaments springs from a narrow frilled membrane of pure white. They are themselves purplish-red, with darker spots, and each filament bears, besides its fringing pinnæ, several curious appendages, by which the species may be easily distinguished from all others. These are little flattened projections, set in pairs, at intervals, on the outer side of each filament, and arching downwards. The dark spots are placed at the base of these tubercles. Of their nature and function I am quite ignorant.

XXXVI.

ST. GOWAN'S.

The Ridgeway—Its Formation—Story of a Thunderstorm—Round Tower—The Cleddau—Ash-trees—Pembroke—Best View of the Castle—Stackpole Court—Lake—Swans—Petrox Church—Bosheston—Peregrine Falcon—St. Gowan's—Legends—The Steps—Magnificence of Scenery—Lichens—Chapel—Wishing Cell—Popular Superstition—Ancient Date—The Rocks around—St. Gowan's Head—Sea-Gulls—The Well—The Bell—Legend—Suggested Rationale—Ridged Periwinkle—Perforated Cavern—Fine Sea-weeds—Seals devouring Prey—Chasm—The Huntsman's Leap—Bosheston Mere—Danish Earthwork—Sunken Wood—Bull-slaughter Bay—The Caldron—Its Extraordinary Sublimity—Wraath—The Stacks—Bird Stations—Archway—The Wash—Night—St. Ann's Lights—Glow-worms.

August 12th.

THERE yet remained one grand sight to be seen, which was to be our last; not that we had of purpose reserved it as a *bonne bouche*, but from unsettled weather, its distance, the conflicting engagements of the various members of the proposed party, and various other causes, the visit to it had been postponed from day to day, till we found it almost thrust out of our stay in Wales. It was the magnificent coast scenery in the neighbourhood of St. Gowan's Head.

We again enjoyed the valued society of our Gumfreston friends; and the Rector, who is an accomplished geologist and antiquary, gave us the benefit of his local knowledge, in an interesting commentary on the objects of note.

Again we passed along the summit of the Ridgeway, that great upheaved chine of the red sandstone, the steep sides of which are flanked on either hand by the broken stratum of compact limestone, dipping down to the sea on our left, and on our right into the valley of St. Florence. Hence this latter is a valley of elevation, not of depression, being produced by the uplifting of the underlying strata, above its level. The valley itself is an alluvial bottom, and tradition states that ancient ships have been dug out of its deep mud.

Just beyond Gumfreston our attention was directed to a cottage on a hill; one of a low range that represents in succession the Procella Mountains, Plinlimmon, Cader Idris, and Snowdon; each of these sub-parallel ranges rising higher and higher, till from these low slopes we arrive at the loftiest peaks in the kingdom.

"But let me tell you," said my excellent friend, "a story of a thunderstorm. You see the cottage on that eminence to the right. I was sitting in my study one Saturday evening, when, during a storm, there occurred a flash of lightning so blinding in its glare, followed instantly by a crack of thunder so loud and explosive, that I went out to my family, and expressed my conviction that some object had been struck by the electric stream in our immediate neighbourhood. The next morning, in proceeding to my ministerial duty, I saw that this cottage, which was what the Welsh call a *green* house—that is, one newly built—was injured; but it was not until the next day that I investigated the history of the case.

"I found that the lightning had made an entrance in the gable end, where an aperture had been forced as large as a cart-wheel; that it had proceeded through the house, making its exit at the other side; thence it had ploughed up a deep furrow several feet in width, along a grass field, for some hundred yards, and, meeting a hedge in its course, had burst through, scattering the bushes, and trees, and earth, on every side.

"Within the house the effect had been curious. The good woman's daughter had a handsome Bible, which had been presented to her for good behaviour at the Sunday School; the covers of this book had been grievously torn and defaced by the lightning, as I will show you some day, for the Bible remains in my possession still.

"But the matron herself was the most remarkable example both of exposure and preservation. She had been struck by the terrific stream, and yet remained uninjured, though not unscathed. It had smitten her on the side, where, by her desire, I looked on a mark as large as a dinner-plate, turned of the colour of blotting-paper, yet without any other sensible injury than this discoloration. Thence it had passed down her side and leg to her foot, and had spent its fury on a Welsh clog, which she wore—a heavy unwieldy affair, with a sole of wood an inch thick, and a heel much loaded with iron—tearing it to fragments, yet leaving her foot entirely unhurt."

Such was my friend's narrative, which seemed to me sufficiently curious to be worth taking down from his mouth, and to be repeated to you.

On another of these low eminences stands the remains of a round tower, evidently of great antiquity. There is another in more perfect condition on Penally Burrows; but archæologists have not yet agreed as to the origin and purpose of either. Some consider them to have been only Welsh beacon-towers in the Flemish wars of the twelfth century; but others, with more probability, identify them with the Round Towers of Ireland. If this identification be correct, these are doubtless among the very oldest specimens of human workmanship in Britain, coeval with that remote era when the ships of Tyre came to Cornwall for tin, and the British Isles were colonized by the Phœnicians. For it is pretty well established that the Round Towers were devoted to the worship of Baal, whose sacred fire, kept alive at its summit, was represented by the elongated conical form of the structure.

We got a fine view of Carew Castle across a barley-field; and of a "Pill" or branch of Milford Haven, glistening like silver in the distance, with the Cleddy or Cleddau beyond. The name of this river is said to be derived from a fancied resemblance to a sword and hilt, the word "Cleddau" in Welsh signifying a sword. I do not know whether the etymologists connect this word with the Latin "gladius;" but the resemblance is obvious.

The Ash is the characteristic tree in this part of Pembrokeshire. It fringes every road, and springs from every hedge. All the self-sown trees are of this species. Oaks of very small size occur occasionally, but I believe only where planted; and the Elm is almost unknown as a hedgerow tree.

We passed through the town of Pembroke, and, while baiting, I took another glance at the Castle. At the bridge we perhaps get the best view of the great gateway over the Hogan; but I think one superior to this for general effect, and the best I have seen, is obtained from a coal-yard on the west of the Castle, in which is a flight of stone steps, from the top of which the Keep is seen in full grandeur. Here, too, the scarped rock on which the pile is built seems to be part and parcel of the whole; for it cannot be distinguished from the masonry, the ivy which drapes the one assimilating to the herbage of the other, and concealing the union of the two. A little out of the town, again, as we mount a steep hill, we get a fine bird's-eye view of the town and castle; the latter relieved nobly by a background of wooded hills.

Our road led through the grounds of Stackpole Court, the seat of Lord Cawdor, by a lake on which a swan was proudly leading her brood of cygnets, through mazes of *Potamogeton natans*, and groups of water-lilies as white as her own plumage, that rose and danced on the wavelets as she ruffled the water with her snowy breast. The beeches, chestnuts, and elms in the park are fine; and they are the more thought of here, from the general scarcity of these trees.

We were now not far from the sea, though no sign of its proximity was apparent; nor should we have suspected it, as we rode alternately through noble woods, pleasant lanes with expanding prospects on either side, and verdant vales receding at intervals. Petrox Church, crowning a hill-top, comes into view, and disappears, again and again, as we wind along;

and we pass through the ancient-looking village of Bosheston, with its grey Flemish tower. Here we saw the Peregrine Falcon flying over our heads; its rapid but easy flight conveying the idea of great power. The rooks, that had before been clamorously cawing on every side, winged away when the robber-bird hove in sight, and disappeared in a marvellously brief time.

The lanes and hedgerows had ceased, and we had been for some few minutes driving over the short turf of an open down, close to the edge of a stupendous precipice, with the sea far below, when we came abruptly on a deep chine or chasm in the limestone rock. Here a series of small steps, apparently cut out of the solid rock for the most part, leads downward to the Chapel of St. Gowan, or Sir Gawaine, as some choose to have it, the nephew of the renowned King Arthur.

The whole place is full of legends and "proofs" of miraculous power. The chasm itself is said to have been cleft in order to give shelter to the saint when sorely beset by pagan pursuers, and to have closed upon him, opening again for his release after the danger was over. The steps are believed to baffle all attempts to count them; so that they never give the same result to two individuals together, nor to two successive attempts of the same reckoner. I was silly enough to test this miracle by counting them twice; perhaps it was my unbelief that prevented the miraculous energy; but I made the number seventy-three the first time, and seventy-three the second, exclusive of broken and fragmentary

ones. Here, I believe, is the true explication of the matter; a considerable number of the steps are so crumbled away, that you may count them separately, or two as one, with equal reason; and unless you take particular notice what choice you do make, the probabilities are that on a second essay you would determine differently.

The scenery here is of the wildest magnificence. The narrow chasm, cleft perpendicularly before us, admits a view of the sea; while the rocks, huge and angular, look like vast ruined Cyclopean walls, tufted with the dark-green samphire, and tinted with many hues, especially yellow, grey, and orange, by the incrusting Lichens of the genus *Parmelia*,* &c., which are so often confounded with the Mosses:—

> "——— the *Moss* of many a hue,
> That varies the old tree's brown bark,
> Or o'er the grey stone spreads."

The steps lead down into the hermitage, or chapel, which, though only twenty feet long, extends right across the fissure from rock to rock; so that there is no possibility of getting down to the sea, except through the chapel. It is shaped out of the solid rock, with some help from masonry; and tradition has delivered that the body of the saint lies buried in its floor. At the west gable, there is an arch for a bell; at the east end, a flat hewn slab once served for the altar; and on the north side is a square niche,

* Many of these incrusting Lichens are valuable to the dyer. Thus the common pale yellow one (*P. parietina*) yields a colouring substance of a bright yellow, which is rendered more brilliant by acids; while a very small addition of some alkali, such as ammonia, changes the hue to a rich purplish red.

beneath which is a well about a foot square. The mud of this little cavity is supposed to have supernatural healing properties; and ignorant devotees still resort to it for the purpose of anointing weak eyes.

Close to the altar six steps lead up to a chamber, in one side of which is the "wishing-cell." It is an upright cavity in the solid limestone, bearing a rude resemblance to the figure of a man, but with sharp diagonal ribs; whence it has been compared to the "matrix of a skeleton." The prominent parts of the interior are polished as smooth as glass, from the friction of the clothes of the multitudes who have in so many ages rubbed against them. For this cell is the very central seat of the supposed miraculous manifestation; the "saint" having been enclosed in this cavity, which, opening to release him, retained his form ever since. The popular superstition is, that any one entering the cell, and forming a wish as he turns himself round, will certainly obtain his desire, provided that wish be not displaced by the rising of any other while there. Here, doubtless, lies the wit of the hoax; for most of these superstitions contain a sort of practical joke,—a latent loophole whereby the reputation of the wonder is secured against the effects of manifest failure. It is next to impossible to turn without knocking your elbows or your head against the points of the rock, and then next to impossible not to wish that you had not hurt yourself; which if you do, you have spoiled the spell!

High up on the west wall there is an area with the date 1116 in ancient characters, with other cha-

racters over it, indented in the old plaster; these were illegible to me.

The little edifice has a vaulted ceiling; three windows, one of which commands a noble view of the sea between the rocky heads; and a door at the south-west corner, from which we descend by about a score of very rude steps to a landing-place, or area, covered partly with grass, and partly with fallen masses of rock from the cliffs on each side, which rise absolutely perpendicular.

It was with sensations of no common delight that I sat down on one of these rude stones, allowing the party to go on out of sight and hearing, and enjoyed in solitude the grandeur of the scene before me. It was indeed a scene of grandeur. The cliffs stand up on either hand, like enormous walls; for the strata here are all horizontal, and the cleavage perpendicular. The right *wall*, if I may adopt the figure, terminates in a columnar mass, like an obelisk; but of far more colossal dimensions than Thebes or Luxor ever saw, isolated nearly to the base. On the other side is a succession of precipices of enormous height, formed of red ferruginous limestone, which at length run out into the sea, a great square-sided promontory (the St. Gowan's Head of the charts, I presume), in which the stratification, in conspicuous horizontal lines, resembles gigantic courses of masonry; and numerous dark caves at the water-line tell of the fury of the waves, that have for countless ages been dashing against that strong barrier. The sea was now sleeping in treacherous calmness, reflecting the sweet soft blue of the sky above, "like a molten looking-

glass;" and it would have been hard to believe, if one had not known better, that so beauteous and peaceful an element could ever be so terrific an instrument of power as it is when awakened by the stormy wind and tempest. How grand must be the spectacle to sit here in one of our autumnal hurricanes, when the angry billows, swelling with the accumulated impetus of the whole Atlantic, rear themselves against yonder impregnable headland, hurl against it all their artillery, and fall back to repeat the shock, a thousand and a thousand times, but all in vain! How grand to hear the hollow roar of the booming wind amidst the caves, and the surging of the crested waves on these rocks below my feet, now covering them with snowy foam, then exposing them all black and bare, while the long oar-weeds and olive tangles wave and toss to and fro, like the dishevelled locks of Bellona, amid "the rapture of the strife!" The white-winged Sea-gulls are coursing and wheeling over my head, uttering their plaintive cries, as if they meant to tell me of the sad scenes they have often witnessed here, where all is now so bright and beautiful. Truly it is a spot to lift up the soul in adoration of Him, "which by his strength setteth fast the mountains, being girded with power; which stilleth the noise of the seas, the noise of their waves, and the tumult of the people.

I rose, and followed my friends. A little below the area where I had been sitting is a well, with good seats of stone around it, and in front a square area, where the poor deluded pilgrims and sick votaries were wont to sit. The well is a puddle of dirty water and red clay; the virtues of which are believed

to be enhanced by a visit to a small house close by, with tall sloping roof. Formerly persons came from all parts of Wales to bathe their diseased limbs in this well of supposed saintly virtue.

Just above this there is a great rounded mass of fallen rock, which, when struck smartly with another stone, gives out a ringing metallic sound. Hence it is called the Bell. Its property is, of course, esteemed miraculous, and has a legend to explain it. A band of marauding Northmen, landing here in one of their roving excursions, plundered the chapel of its bell. That the "saint," however, might not be deprived of this ecclesiastical accessory, so particularly useful in this case, where there was nobody to be called to devotions but himself,—the sonorous property of the metal was communicated by miracle to this stone, which the bell had touched in its descent to the water. I found, however, that this ringing power was possessed by a good many of the boulders in the wilderness of stones over which I had to clamber in my way down. It is probably dependent on the compact character of the stone, and the manner in which the mass rests on its supports, so as not to interfere with the rhythmic vibrations; the points of contact, perhaps, being situated at their nodes.

Farther down still we come to a level, where the rock is of an umber-brown hue, completely honeycombed, and full of greater cavities. The water at spring-tides reaches up to this; Limpets were numerous; and specimens of the Ridged Periwinkle (*Littorina rudis*), which is always found high up on the rocks, enduring the burning sun of summer with

impunity, were abundant. This little Mollusk is very pretty and attractive, from the varieties of colour which its shell assumes; light grey, pale green, yellow, orange, and scarlet, being the principal. The species may be readily distinguished from the young of the Common Periwinkle, not only by the situations it affects, but by the number of sharp ridges (about eight) which run round the shell, parallel with the whorls. They were here in incredible abundance, filling every hollow; for the most part small (from an eighth to a quarter of an inch in height), and almost all of the pale scarlet variety. Rough excavated rocks above high-water mark of ordinary tides are the abodes of this pretty species; and hence it is not practicable to keep it long in an Aquarium, where its beauty would make it a desirable tenant; as immersion kills it in a few days.

I made my way along a narrow flat ledge under the right cliff, into a perforated cavern beneath the great obelisk. It was floored with the most lovely purple pools. Thence I walked out on an open area, full of dark shadowed hollows, in which were growing some fine Sea-weeds—such as *Delesseria sanguinea, D. hypoglossum, D. ruscifolia, Griffithsia setacea*, and many others—which ordinarily are not to be met with except at the lowest level of spring-tide, while this level was not much below that of half-tide. The cause of this deviation from ordinary habit was doubtless the darkness of these sheltered pools; the light being wholly intercepted on one side by the lofty cliffs, and from other quarters by great masses of overhanging rock.

In these most charming basins my young friends obtained many interesting specimens of animals and plants; nor was my own search without success. I will not now, however, interrupt my narrative to detail the particulars; but hasten on. Before we left, my friend the Rector directed our attention to a flat platform of rock not far off, where, as he was one day standing there, he saw a Seal in the sea tearing to pieces a fish which he had captured; the animal presently coming to the surface, and entering a cavern beneath his feet.

This story reminded me of two similar anecdotes told us by young Mr. Heaven, when you and I were exploring Seal Cave, in Lundy Island. Possibly you may remember them; but as I took down his words, I will repeat them, as illustrating a habit of the animal, thus confirmed by two observers.

"I was one day standing here," said he, "when I saw in the water below, which was clear and smooth, a large Seal come up to the surface, carrying in his mouth a Conger-eel, perhaps some eight or ten feet long, and as thick as my leg. The animal played with his prey, exactly as you have seen a cat play with a mouse; letting it go, then darting after it, as it sought to escape, and catching it with perfect ease. All its motions were full of grace. At length the Seal bit the fish in sunder with one snap; and allowing one portion to sink, he ate from the other till he reached the head. This he rejected, throwing it from him; then dived for the tail, which he brought up, and ate in like manner.

"On another occasion, near the same spot, I ob-

served a Seal treating a Salmon, which he had caught, after a similar fashion. It was astonishing to see how utterly powerless were all the attempts of the Salmon to escape before the rushing pounce of the Seal; it was overtaken and seized in an instant. When he was tired of his play, he suddenly tore off a large portion from the fish's side; and I assure you that the severing of the muscles was distinctly audible where I stood. In this instance the creature devoured the back part first, and, like an epicure as he was, reserved the belly for the *bonne bouche*."

After an hour spent delightfully in the romantic scene I have above described, we climbed to the grassy summit again; and, turning to take one more look at what I thought the most sublime scenery I had ever beheld, we walked forward along the edge of the cliffs.

A few hundred yards onward we came to a long deep gorge, with sides quite perpendicular, the sea filling the bottom. White and grey Gulls—I think chiefly of the Kittiwake species—were sitting by scores on the shelves and ledges of the walls, uttering their querulous cries, and bearing the closest resemblance to pigeons.

Another similar chasm, equally deep, equally precipitous, but much more striking because much narrower, then occurred. At one point, the walls approach so as to touch about mid-height, receding both above and below. We admired the fine effects of the light on the sea, discerned through the far distant cleft at the bottom. This is called the Huntsman's Leap, from a tradition, that a sportsman in the

heat of the chase, coming unexpectedly on the chasm, and unable to rein in his steed, boldly took the awful leap with success. I walked to the narrowest part of the chasm: it is certainly just possible that a horse could clear it; though, as the edges cannot be less than sixteen or eighteen feet apart, and the slope of the turf on each side is abrupt, it makes one's blood chill to think of it.

Beyond this is Bosheston Mere, a small round hole in the turf, which leads down to the sea below, in a slender natural pipe or tunnel. At all times the washing of the waves produces a hollow booming sound, that reverberates through this hole; but when a heavy sea is breaking on the coast below, a column of spray is projected at every wave from the mouth of this spout, to the height of thirty feet; and the report, like that of artillery, is said to be distinctly audible for many miles round. It is dangerous to approach at such times the mouth of the tunnel; for, as the wave falls back, the air rushes in from above with great violence to supply the vacuum; and it is currently reported that sheep grazing near have been sucked in and engulphed by the violence of this reaction.

Close to this spot there are rows of green banks, which mark the position of an ancient earthwork, ascribed to the Danes. And here we turned inland a little to look for the Sunken Wood, which, after some brief search, we found. This is a place of great interest. A round pit some fifty feet wide, and the same in depth, yawns in the ground. It is full of ash-trees, which, springing from all parts of the

bottom and sides, just reach to the summit, and no more; a curious example of the influence of the spray from the sea in preventing the growth of trees. The little shelter afforded by this depression of the surface is all that is needed for the luxuriant growth of trees; which, however, no sooner arrive in their upward progress at the level of the wind that sweeps along the land from the ocean, than their growth ceases at once. Nor do trees alone avail themselves of this shelter: Ivy richly covers the grey trunks; the large leaves and stout pillar-like stalks of the Hyacinth were covering the bottom, testifying to the geniality of the situation for that lovely flower; and Ferns of several species—the male Shield-fern, the elegant Lady-fern, and the long green ribbons of the Hart's-tongue—with herbage of many other kinds, draped this hollow with profuse verdure, and made it quite a charming little retreat, especially to those of us who scrambled down through the fringing brambles into its dark recess.

This hollow reminded me of those sunken pits which I have seen in Jamaica, where they are called Spanish Holes, and one of which I have described elsewhere.* I believe they are not very uncommon in the limestone formation, and are, I presume, formed by the falling in of the roof of what was originally a concealed cavern.

Approaching the margin of the land again, we come to a chasm which bears the name of Bull-slaughter Bay. We looked down on an attractive little cove, with a beach of smooth yellow sand, girt

* Birds of Jamaica, p. 25.

by lofty cliffs, the strata of which are irregularly distorted, though nearly perpendicular, sloping away in opposite directions. We mused on the strange name, and wondered what legend of blood was attached to the place; when fat George, the lad who drove us from the White Lion, came to our help with a story of a bull that fell over the precipice. Of course, if such an incident had occurred, the animal would doubtless be effectually "slaughtered;" but our antiquarian friend, who has no mercy on legends, hinted that Pwll-slater is the true orthography,—a Welsh compound having very little relation to bulls or butchers. What, however, the aforesaid Pwll-slater does mean, "this deponent saith not."

But now we came to the Caldron,—a chasm of exceeding grandeur, surpassing in sublimity anything I had yet seen. I have difficulty in describing it intelligibly without diagrams. It is a somewhat circular pit, with absolutely perpendicular sides, about two hundred feet in depth; its width may have been about the same, but I had no standard of measurement, except that one of our party, a stalwart youth, repeatedly struck the opposite wall with a stone thrown with his utmost force. It is surrounded for more than half its circumference by the sea; the dividing wall of rock, which is very narrow, bending round for nearly three-fourths of a circle. In this wall, on one side, is an arched passage, through which we could see the blue and sparkling sea; while, on the other side, nearly opposite, a narrow fissure, like a tall doorway, led out to a little cove. Near this doorway, but on the landward side, we could see

the light through a crevice, which we found to communicate with another pit, exactly like the main one, but much smaller, and oval in outline, which lay immediately behind the little cove already mentioned.

No description, or at least none that I can pen, would do justice to this extraordinary chasm, or convey any adequate impression of its sublimity and grandeur. The immense depth, the rounded form, and the steep upright walls, with arched passages, and narrow doors, might make you fancy that you were looking down from the battlements of an old castle-keep into the interior, only that it must have been the keep of a giant; perhaps one of those "Welsh giants" whom we used to read of in our babyhood, conquered and slain, in good King Arthur's days, by the redoubtable "Jack." The length of time that a stone was occupied in its descent, the interval that elapsed before the sound of its fall came up to the ear, the feeble distant sound that it was when we did hear it, combined with the eye, that travelled up and down the mighty walls to measure the height, in giving an idea of great vastness; while the hundreds of gulls that filled the mid-air, or wheeled in successive gyrations, circling round and round, from the bottom to the top, helped the mind to conceive the magnificence of the spectacle.

The whole of this enormous cavity is enclosed by another Wraath or earthwork, of considerable extent, an ancient Danish encampment; a memorial of the time when the bold and lawless Sea-kings infested the coasts of Western Europe, and made their piratical incursions on every land. A steep and narrow

path winds down from the camp to the little cove, which sufficiently indicates the spot in which the pirates were wont to land, and the mode in which they obtained access to these apparently impregnable heights.

The inspired Preacher tells us truly that "The eye is not satisfied with seeing, nor the ear filled with hearing."* No sooner had we well gazed on one grand, or beautiful, or wonderful scene, than on we posted, eager for the next. Presently we came to another of those deep indentations of the lofty cliff that we had seen so many of; a beach of smooth sand at the rear of the cove, and the clear green sea rippling upon it; while at the very entrance of the inlet, about equidistant from either projecting bluff, and from each other, rose two lofty perpendicular isolated masses of rock, each on a long and narrow pedestal shelving to the water's edge. One might fancy that it was the portico of some gigantic Grecian temple, with a colonnade of two pillars, or what is technically termed *distyle in antis;* and that the pediment which these pillars once supported having fallen, the columns, ruined and shattered, remain standing in solitary grandeur.

Here again the sea-fowl were numerous; and every shelf and narrow ledge, and especially the pedestals, were white with guano; while the incessant cries of "Kittiwake, Kittiwake," seemed to fill the air, and to stun the ear with their clamorous din. But what we saw to-day was nothing compared to the population of the place a month or six weeks ago, and the

* Eccles. i. 8.

sounds we heard are not to be compared with the deafening screams that would have saluted us had we visited the place at that season. For these rocks are the Stacks, known as one of the stations whither resort uncounted millions of sea-birds during the month of July, to lay their eggs and bring up their young. I the less regretted this accompaniment on the present occasion, as I had already witnessed the strange sight; for neither you nor I will readily forget our visit together to the Bird Station at Lundy Island, in the summer of 1852; and I doubt not you can recal, as vividly as I do, the myriads upon myriads of Puffins, Auks, and Guillemots that filled the air, like a whirling wheeling cloud, as we walked down the treacherous steep; where myriads more, sitting on their eggs, gazed aslant on us as we passed close to them; the Gulls of several species that sat in long white and blue lines, row above row, on the rocky shelves; the Gannets and Cormorants on the insular peaks; and the crowds of all kinds that blackened the heaving sea as far as the eye could reach. Truly, that was an incident that can never be forgotten; the sights, the sounds, the smells, were all such as rarely occur to a man more than once in his lifetime, and impress themselves indelibly on the memory.

Yet a little more to the westward we saw with admiration another stupendous work of the Divine Architect, all whose handiworks hereabout seem characterized by grandeur of dimensions, and stern simple sublimity. It was the Archway. A great perpendicular ridge runs out from the coast into the sea. A little way off from its point, a huge block, taking the form of

a castle or thick tower, stands up out of the water. In the midst of the ridge, an arch of magnificent height and span goes through it; affording a peep of the distant cliffs, like a bright sunny picture in a frame of carved oak. It reminded me of that arch near Lulworth, in Dorsetshire, called Durdle Door; but that is far surpassed by this in dimensions and picturesque grandeur. The green sea, as we saw it, did not reach the floor of the vault; but at high water it passes clean through, when the effect would no doubt be finer still.

Thence we came to The Wash. It was approached by a sloping green valley, down the centre of which was a bed of rounded boulders, as if a torrent of great force had once poured down this glen, and carried these stones with its current. At the bottom we opened an immense flat area of fossiliferous limestone, full of great bivalves, and long tubuliform or cylindrical Madrepores, some two inches in diameter, others about one-fourth of an inch, and set in great numbers very close to each other and parallel, something like the pipes of the *Tubipora musica*. The strata were not quite horizontal, having a slight dip to the north—that is, landward; so that, on the seaward edge, they form terraces, about a yard in height, the thickness of the strata. One stratum was laid bare beneath the tall cliff, for a space of two hundred yards in length, by forty in width. And this was so totally different in its character from anything we had as yet seen, so peculiar in itself, that the effect on our minds was highly gratifying. The reason of the appellation given to this singular plat-

form is, that the sea, when it rises to the requisite level, flows over the whole with a sweep, washing the whole surface at every wave. In the bird-season it is a favourite resort of sporting visitors, who, taking their station at any point, may kill their worthless game in any required quantity without moving,—a sport about as exciting, one would think, as killing deer at a *battue.*

I hope I have not wearied you with these detailed descriptions: they can give you but a very faint idea of the strange scenes themselves, the sight of which kept our minds in a sort of excited, bewildered delight for more than half a summer's day. All that I have mentioned occurred within a line of coast three miles in length: I suppose there are few points of the same dimensions in England that would present so varied a succession of wonders. Yet we had no reason to believe that we had exhausted the sublime or the beautiful: on the other hand, I have no doubt that if we had been able to examine in detail the whole coast, as far as the mouth of Milford Haven, or perhaps. even to St. David's Head, we should have found it of a similar romantic character, and perhaps have discovered still stranger marvels of scenery.

But night had already fallen,—a balmy summer night,—and we had many a mile to drive before we could refresh our bodies with supper and bed. When we were near Bosheston, we saw, with that interest which the sight of an object so valuable to mariners always excites, the twinkling lights on St. Ann's Head, on the opposite side of Milford. They appeared only like dim stars, it is true; but we could see that,

while the upper of the two was permanent, the lower, by its periodical diminution and increase, was a revolving light. After passing Pembroke, numbers of glow-worms, in the herbage of the hedge-banks, displayed their tiny lamps; as if they would perform, in a small way, their services as light-houses to us on our homeward voyage. They were the more pleasing to me, because it is many years since I have seen these interesting insects; though meanwhile I have been familiar with their more illustrious cousins—the fireflies of America and the tropics.

It was midnight when we got home, going round by Gumfreston with our friends, and picking up our little Willie, who had been kindly entertained there while we were lion-hunting.

XXXVII.

SEA-ANEMONES.

The Orange-tentacled Anemone—The Orange-disked Anemone—The Glaucous Warty Anemone—The Snake-locked Anemone—The Rosy Anemone—The Daisy Anemone—The Snipe's Feather Anemone—The Snowy Anemone—The Plumous Anemone—The Common Smooth Anemone—The Furrowed Anthea—Reproduction of Parts — Spontaneous Fission — The Auricled Lucernaria.

August 17th.

OUR pleasant holiday is now come to an end: to-morrow we expect to leave at early dawn by the Steamer for Bristol. This last day, then, I purpose to devote to the bringing together of the observations I have gleaned on the *Actiniæ* of this vicinity, even at the risk of repeating some that are scattered in the course of the preceding letters. In doing this, I shall begin with describing such species as I believe to be new. These are three in number.*

Sagartia aurora.† The Orange-tentacled Anemone.
(Frontispiece.)

The body in contraction is a hemispherical button half an inch in diameter, of an umber-brown hue, occasionally varying to olive, marked with narrow

* These three species were subsequently described by me in the Annals and Magazine of Natural History for October, 1854.

† See Appendix, No. II.

P.H.Gosse del. et lith. Vincent Brooks Imp.

a. b. The Orange-disked Anemone.

c The Glaucous Warty Anemone.

longitudinal pale bands, which become wider and more conspicuous towards the base, and obsolescent at the discal margin, where the brown hue is deepest. The pale bands are separated by about four times their own width, but have at the base several short and vanishing pale lines between them.

The exterior of the body is studded with numerous pale oblong sucking-glands, not prominent, to which grains of sand, fragments of shell, &c., adhere strongly.

The tentacles are about eighty in number, set in four rows, of which the inner row contains about six, a little more prominent than the rest, and often either perpendicular or bent over the disk; the others are set so irregularly, that, though there is an approximation to a serial arrangement, they can scarcely be distributed into rows, except arbitrarily. The external ones are the smallest. They are moderately thick at the base, tapered to a blunt point, and the longest about equal in length to the diameter of the disk. They are pellucid at the basal moiety, and nearly colourless; thence they are tinged with orange or red-lead, faintly at first, but becoming very brilliant at the tips. Under a lens this colour appears to be superficial, and to be composed of minute dust-like powdery specks; but, on submitting the tentacles to pressure under a power of 220 diameters, I find that the red pigment is deposited on the *interior* surface, from which it escapes by the rupture of the walls. The latter are somewhat thin, yellowish, clear, and full of minute thread-cells of the usual form, and about $\frac{1}{1000}$th of an inch in length.

The disk is variegated with dark brown, greyish drab and white; the former two colours arranged irregularly in a minute pattern, the latter forming a circle of opaque white spots, surrounding the mouth. The angles of the mouth are indicated by a pale band, which passes from each across the disk, in which are conspicuous the ovarian orifices.

The pattern of the disk is often the same as that of *troglodytes*, but is never so distinct: in some specimens only the ring of white spots can be seen on a blackish-olive ground; in others nearly the whole disk is yellowish-white. One specimen (which I take to be a variety of this species) has all the tentacles pure opaque white, without any trace of orange, and the disk also white, marked dimly with grey.

I find it in one of the caverns of St. Catherine's Island, where it is common, in company with *S. troglodytes*, and with the same habits.

One specimen in my possession produced young freely, ejecting them from the oral aperture four or five at once. They varied in size, from that of a mustard-seed downwards; were very prettily marked, with radiating white bands on a yellowish ground, when contracted; and displayed, when expanded, from twelve to eighteen orange tentacles.

Sagartia venusta. The Orange-disked Anemone.

(Plate XXIII., figs. *a*, *b*.)

Button about half an inch in diameter, and the same in height. Flower-like expanse one inch wide. The button varies from deep buff to rich brown-orange, studded with minute pale sucking-glands,

and marked around the base with short and vanishing longitudinal pale lines.

Tentacles about two hundred or more, not in distinct rows, the inner ones about as long as the diameter of the disk, the outermost small and close-set; slender, acute, somewhat flaccid; pure white, becoming pellucid at the base, and sometimes at the tip.

Disk commonly ovate, wholly of a brilliant orange or red-lead colour, with no markings except the indications of internal structure, which are dimly visible through the integument. Its surface is plane; the mouth a simple orifice, without distinct lips or cone.

This most elegant species I have met with only in this neighbourhood, where it is so abundant as to be quite characteristic. It occurs all along the south coast of Pembrokeshire, at least from Monkstone Point to St. Gowan's Head, but is more than usually numerous in the fine perforated caverns of St. Catherine's Island, that form such an attraction to Tenby visitors. It is a troglodyte species, almost invariably choosing for its residence some crevice or cranny, or one of those little cavities made by boring mollusks, with which the limestone here is so generally honeycombed. Though we often see it in shallow pools with a bottom of mud, we invariably find on examination that it is attached to a hole in the rock beneath, protruding its body through the deposit by elongation, and expanding its beautiful disk on the surface. From this habit it is difficult to procure, notwithstanding its abundance, as it must be chiselled out,—an

operation, which, from the great hardness of the limestone, is both tedious and precarious.

Hundreds may be seen in the largest of the caverns alluded to, hanging down from the walls during the recess of the tide; the button elongated to an inch or more. They expand very readily in captivity, displaying the brilliant disk in full, fringed with its elegant border of white tentacles; yet not unseldom do we see the margin puckered into frilled folds, in the manner of *S. bellis* and *dianthus*, though to a less extent.

This species has close relations with *S. nivea* and *S. rosea*, especially with the former. Its colouring, however, seems constant, without any tendency to albinism; and its habit of throwing the margin into puckers, and its tendency to an ovate outline, also distinguish it, though less satisfactorily. From *rosea* it is better distinguished by its superior size, and by the greater comparative thickness of its inner tentacles, which also are more discal, whereas in *rosea* they are all marginal. All the three species throw out white filiferous filaments in great profusion when annoyed.

The thread-capsules of the filiferous filaments are of two kinds. The one is larger, oblong, with rounded ends, emitting a thread about thrice as long as itself, abruptly pointed, and clothed, from the basal third outwards, with close-set reverted hairs, which appear to be set on the thread in a spiral direction. The thread before emission is very distinct, running through the whole length, slightly bent, and gradually merging into the outer end of the capsule. In

some instances a thread is discharged in every respect agreeing with that just described, but perfectly simple, and without barbs. I think that this occurs when the emission has been very slow; that the barbed hairs fly out only when the missile force is sudden; that otherwise they continue appressed to the sides, and invisible. I can discover no trace of the spiral in the unemitted thread.

The other kind of capsule is of the same form as this, but only half the length. The thread also looks the same before emission, but, when expelled, tapers to a fine point. A spiral band, internal, or at least not projecting from the surface, runs loosely round the thread, from its base as far up as the thickness allows it to be traced.

Bunodes thallia.* The Glaucous Warty Anemone.

(Plate XXIII., fig. c.)

Button one and a quarter inch in diameter, usually one inch in height, but capable of elongation to double this altitude. Expanded flower two inches.

Button pale bluish-green, studded with prominent warts of a darker hue, set in twenty-five to thirty longitudinal rows, about twenty-five in each row; the topmost or marginal wart becoming an elongated pale tubercle or rudimentary tentacle.

Tentacles about forty-eight in number, in two rows, equal in size; thick, obtuse, scarcely more than half as long as the diameter of the disk, even when extended:—pellucid greyish-brown, with a longitudinal, undefined, dark-brown streak along the facial side of

* See Appendix, No. II.

each, on which are placed irregularly several specks and splashes of opaque white, varying in number, shape, size, and position.

Disk a many-rayed star of yellow rays on a blackish ground: thus produced:—the tentacles of the inner circle have their discal ribs blackish, with a spindle-shaped spot of yellow near the mouth; those of the outer row are similarly marked, but the yellow spot is drawn out to a long line, dividing the primary tentacle-ribs from each other: these lines make the rays of the facial star.

This is a very well-marked and constant species: out of a dozen specimens that I procured, no two differed in any appreciable degree, except in size. It approaches close to *B. gemmacea*, from which, however, it is easily distinguished by colour, and by its superior dimensions.

I found it in only one locality; in the dark angles and pools of a little insular rock, exposed at spring tide, that lies just off the Cove called the Droch, near Lidstep, on the east side. It is not troglodyte in habit, but adheres to the open rock, and is therefore easily detached. It is very social: I almost invariably found four or five clustered together in a lump, each pressing upon the sides of the others.

In captivity it is shy of expanding: it is also reluctant to adhere, and very readily detaches its base, either wholly or in part; when it will frequently remain for days without again affixing itself. If the water become stale, it manifests its impatience in this way, and dies sooner than most species. Like *gemmacea*, it throws off successive rings of mucus

from its body, which accumulate around its base if not removed.

The resemblance of this species to *B. gemmacea* is heightened by the habit of elongating itself in the form of a column, when closed.

It does not throw out filiferous filaments when irritated, but the convoluted bands are protruded from wounds in the base. Examining a small portion of one of these, I found two sorts of capsules: the one of a lengthened oval form, $\frac{1}{900}$th of an inch in length, from which a thread, apparently simple, $\frac{1}{250}$th of an inch long, is evolved; the other more numerous, excessively linear, $\frac{1}{450}$th in length. I am not sure, however, whether these latter be capsules, as I did not see one discharge.

In the skin surrounding the margin the capsules are linear-oblong and very minute, $\frac{1}{1750}$th of an inch in length. Those in the walls of the tentacles are similar in form and size.

I have chosen the specific name from *θαλλία*, an olive shoot, in allusion to the elongated form and glaucous colour of this species.

The next species, though included by Dr. Johnston in his "British Zoophytes," is so imperfectly characterized that I shall describe it also at length.

Sagartia viduata. The Snake-locked Anemone.

The markings of the button in this species are closely like those of *S. troglodytes*, and the pattern of the disk is nearly the same; and yet the general aspect of the two is very different, so that they can be distinguished at a glance. When expanded, the

length and slenderness of the tentacles in *viduata*, and the two dark lines on each, one on each side, are sufficient marks; when contracted, a certain mealy or speckled character is constant about the upper part of the button in *viduata*, which is not found in any specimen that I have seen, of *troglodytes*.

Mr. Huxley gave me a very fine specimen, characteristically marked, which he dug out of the sand at Tenby. Its disk measured fully one and a quarter inch in diameter, exclusive of tentacles; so that the total expanse was two inches and a half. This individual, which was the finest example I have ever seen, used, after it had been in my possession some time, to elongate itself, especially at night, in the form of a perpendicular column; from the summit of which the numerous slender tentacles, arching outwards on all sides, gave to the whole animal somewhat of the appearance of an elegant palm-tree. I have seen the column five inches in height, with a thickness of about two-thirds of an inch.

This was the only example that came under my observation here; but Mr. Huxley informs me that he found several in similar circumstances to the above.

Mr. Price has described this species by the name of *Actinia anguicoma;* an appellation which I adopted in my "Devonshire Coast." But the species is the *A. viduata* of Müller; and notwithstanding the superior significance of Mr. Price's name, it must yield to the law of priority. His description of the animal's habits agrees closely with what I have mentioned above.

The filiferous filaments are protruded reluctantly

and sparsely. They are well ciliated, and contain crowds of long-oval capsules reaching to $\frac{1}{300}$th of an inch in length, with a central linear cell. They emit the wire readily, which is one and a half times the length of the capsule, and armed with a dense beard. I find capsules of only one form, though they vary in size; some being not half the length just named.

Sagartia rosea. The Rosy Anemone.

(Frontispiece.)

In the pools and angles of the rocks about the Droch I found many specimens of this species, which I had hitherto known only by a single individual. It scarcely ever exceeds half an inch in diameter, expanded. The disk is frequently tinged with orange, gradually merging into the roseate hue of the tentacles. It curls the disk into puckered folds.

The capsules of the filaments are $\frac{1}{300}$th of an inch long; they protrude a short thread, scarcely twice as long as themselves, armed with a dense beard, whose setæ are slightly reverted.

Sagartia bellis. The Daisy Anemone.

This is one of our rarest species; only two or three individuals having occurred to me, on the rocks of Tenby Head, as I have described at page 96, *ante*. I must therefore refer to my previous works for what I know of its appearance and economy.*

Sagartia troglodytes. The Snipe's Feather Anemone.

Button from one half to one inch in diameter, and from one-eighth to three-fourths of an inch in

* Devonshire Coast, p. 25; Aquarium, p. 81.

height. Expanded tentacles to one and three-quarters of an inch.

Button olive-green, olive-brown, grey, buff, or drab, always marked with pale or white longitudinal bands, widest and most conspicuous at the base, where the longer alternate with shorter ones, but usually vanishing towards the summit. Whole surface beset with pale sucking glands, more or less visible, chiefly towards the summit, which have a strong power of adhesion.

Tentacles about 48, in four rows—6, 6, 12, 24=48; the innermost largest and decreasing outward: in extension about as long as the width of the disk, conical, bluntly pointed; pellucid grey, marked with black at the base, with a narrow slight semi-ring of white in the middle, and with two conspicuous rings of white near the tip. The intervening portions are often varied with blackish, and with pale-red, dim and pellucid in the ratio in which the tentacle is distended with water.

Disk varied with black, grey, and white, in a delicately-pencilled pattern, that has been justly compared to the mottling of a feather—that of a snipe, for instance. The elements of the pattern seem constant, though some variation in the proportions of the colours causes diversity in the appearance of individuals. The base of each tentacle is marked with a large black cloud, enclosing a heart-shaped spot of grey; within this is a long lozenge of grey, margined with black; then a spot of white surrounded by black; and then a narrow line of pale yellow or drab, margined with black, brings the tentacle-ridge to the oral orifice.

This species is abundant in the largest of St. Catherine's Caverns, ensconced in holes and crevices of the limestone rock, into which it retreats on alarm. Like other species of the same habit—as *S. nivea*, and *S. venusta*, its companions in this Cavern—it is difficult to procure on this account. Nor is it easy to discover specimens, even when scores are exposed and expanded; for the mottled colouring of the disk and tentacles is so like that of the sand and mud of the pools, that even a practised eye may overlook them without the closest searching. They often protrude the tentacles only, clustered perpendicularly, through the mud, and sometimes only the tips of these organs. Their concealment is aided by the collection of sand, gravel, and broken shells, that adhere to the sucking-glands of the body; these substances are often present in considerable quantity, and are retained with pertinacity for a long time, even in captivity.

On the east wall of the Cavern just mentioned, hundreds are lodged; and these are left dry when the tide recedes. Their half-closed buttons are then more readily detected; and the chisel can generally more easily dislodge them there.

In confinement they are soon at home, adhering to any surface: they form a very flat button when contracted, but are not at all chary of expanding. Some specimens greatly resemble *S. viduata;* and when closed, the two species can scarcely be distinguished.

When much irritated by pressure, *S. troglodytes* throws out convoluted filiferous filaments, which are very slender, few in number, and reluctantly produced. These are of the usual appearance, filled with linear-oval

capsules, marked with a median linear chamber, which continues visible after the emission of the short thread; this latter is scarcely longer than the capsule, widely armed with what appear to be beards slanting outwards, like the vanes of a feather. Among them, in far less profusion, yet still sufficiently numerous, are other larger capsules, more ovate in form, which contain a band consisting of a thread coiled in a very regular spiral. Sometimes the band is bent, as if by its own elastic force, pressing on the walls of the capsule. I have seen it projected in several instances to great length, with little force; it is simple. The average length of the linear capsules is $\frac{1}{875}$th of an inch, and their width $\frac{1}{7000}$th. The length of the ovate ones is $\frac{1}{580}$th; their width $\frac{1}{1750}$th. The walls of the tentacles are studded with both kinds, but of smaller size; and the ovate form is more scarce in proportion, and not invariably present.

Sagartia nivea. The Snowy Anemone.

(Frontispiece.)

This species, of which I had before met with only two specimens—one on the south, the other on the north coast of Devon—is very common, and particularly fine on the coast of Pembrokeshire. In the numerous caverns and dark rock pools into which the compact limestone around Tenby is hollowed, this delicate Anemone is seen to advantage, studding the dark rock by hundreds, like bright stars, either singly or grouped in constellations. When covered by water, it expands freely, and continues long

exposed; but, in situations where it is left by the tide, it either withdraws into its hole, or, if this be placed on the side of a perpendicular or overhanging rock, it hangs out in the form of a lengthened nipple, with a drop of water depending from its head, like a dewdrop, in the centre of which a speck of white reveals the peeping tips of the contracted tentacles.

Specimens occasionally show a tendency to those alternate bands of paler and darker colour at the base of the button, that characterize *troglodytes*, *viduata*, and other species.

It occasionally expands to one and a half inch in diameter.

The filiferous filaments are projected with great readiness and profusion. They are moderately crowded with capsules, about $\frac{1}{450}$th of an inch in length, which protrude a thread about thrice their own length. This, in general, appears simple; but, in some instances, I have seen it decidedly barbed. In these cases, it was much shorter.

An infant of this species, that was born in one of my vases, adhered by the base immediately, and presently expanded. It displayed twelve tentacles, set in six pairs; each pair being nearly parallel, and separated by a marked interval from the pair on either side.

Sagartia dianthus. The Plumous Anemone.

As I have already observed, this occurs on the sides of the Third Cavern of St. Catherine's, in small specimens only, of the white and yellowish-olive varieties. I have not met with it anywhere else in this neighbourhood.

As I have already written its history under more favourable circumstances,* I shall here only make an observation on its armature.

The filaments are slender, reluctantly protruded. They are crowded with linear-oblong capsules, about $\frac{1}{350}$th of an inch in length, some of which discharge a short thread about twice as long as themselves, armed with a dense reverted beard; others, of the same form and size, shoot forth a long thread, apparently simple; I saw one extend to $\frac{1}{24}$th of an inch, the tip then slowly lengthening in a spiral.

Actinia mesembryanthemum. The Common Smooth Anemone.

This well-known species is sufficiently abundant here; but the specimens are chiefly of the liver-coloured variety, verging into deep crimson, and of the olive, verging into dark green. The great variety called the Strawberry, dark red, with numerous light green spots, so common on other rocky shores, seems rare, if not unknown, here.

The convoluted bands in this species possess comparatively few capsules; these are nearly linear and small, being about $\frac{1}{700}$th of an inch in length. They do not readily emit their contents, a simple thread, which I have seen protruded to more than twenty times the length of the capsule.

The marginal tubercles or azure spherules are almost wholly composed of capsules, very linear, and about $\frac{1}{390}$th of an inch long. They very reluctantly emit the thread, which I have therefore seen only in

* The Aquarium, p. 189.

few instances. It is very subtile, and of considerable length; but I have not been able in any case to trace it to its termination.

The tentacles are closed tubes, the walls of which consist of two distinct layers. The outer consists of colourless granules, irregular in size and form, but generally sub-globular, and rarely exceeding $\frac{1}{3300}$th of an inch in diameter. Several of these globules have a spontaneous jerking, sub-rotatory motion. In this layer the thread-capsules are set, comparatively few in this species, linear-oblong, and not more than $\frac{1}{1200}$th of an inch in length. They emit a fine thread, apparently simple, and of considerable length. Below this layer is one of pigment granules.

Many of the capsules (or what seem to be such), both in the walls of the tentacles and in the azure tubercles, differ from the rest by being much thickened at one end, which is in some examples turned to one side, and hooked in various degrees.

This species is well known as producing its young perfectly formed, and often in considerable numbers at once; so that it is no uncommon occurrence to find in the morning an individual surrounded by a large family of hopeful children, though, when we looked at it on the night before, it was quite solitary. I divided a middling-sized specimen with a sharp knife transversely; when about twenty young fell out from the interseptal spaces. These were all fully formed, though in size they varied from one-twelfth to one-fourth of an inch in diameter. I could find no sign of ova in the convoluted ovarian bands that spring from the bases of the septa. One of the largest of the young

had thirty-four (normally three sets of twelve each) tentacles; and all of them established themselves at once in the Aquarium, on the pieces of rock and the bottom.

The mouth in this, as in other species, is much corrugated internally, and its angles are marked with spots, which in the green varieties are blue, in the red ones purple: these have been plausibly conjectured to be eyes. I find that at the point where the lips unite, there is a minute oval wart, with a fissure on each side, separating it from the lips; and the wart thus formed is the coloured tubercle in question.

Anthea cereus. The Furrowed Anthea.

Both the brown and green varieties of this widely distributed species occur here in shallow pools—its usual haunt; but not very abundantly. I notice it because of an interesting observation which I have to record concerning its habits.

The power of reproducing lost parts, which made the *Hydra* such a miracle to its early observers, is ascribed also, in scarcely inferior degree, to the *Actiniadæ*. According to Dicquemare, if cut transversely through the middle, the lower portion of the body will, after a time, produce new tentacles, "pretty near as they were before the operation;" while the upper portion swallows food as if nothing had happened, permitting it, indeed, at first to come out at the opposite end,—"just as a man's head, being cut off, would let out at the neck the bit taken in at the mouth,"—but which it soon learns to retain, and digest in a proper manner. In an experiment of this kind,

the upper half, instead of healing up into a new basis, actually produced another mouth and tentacles; so that an animal was formed which caught its prey and fed at both ends at the same time! If, again, the section of the body is made in a perpendicular direction, so as almost to divide it into two halves, these halves unite again in a few days. If the section is complete, two perfect individuals is the result; and to complete the wonder, if the body be torn away, and only a portion of the base remain, from this fragment a new offspring will sometimes rise up to occupy the place of its parent.*

I do not know that any instance is on record of spontaneous division in the Zoophytes proper, or at least in the highly-organized Family of *Actiniadæ*, common as the phenomenon is in some of the low forms; as the INFUSORIA, for example. The following fact, observed by Mr. Dyster, possesses, therefore, great interest, and I give it in his own words, as communicated to me.

"An *Anthea cereus* which had been in captivity thirteen days, devoured with great relish a dead *Pandalus*. I watched the operation of seizing and swallowing; and there was nothing unusual in the appearance of the *Anthea*, on Monday night. On Tuesday morning, going to look at my prisoner, I observed the rejected shell of the *Pandalus* at the bottom of the jar, and to my great puzzlement, instead of *one Anthea* there were *two*, of nearly equal size, but much smaller than my old friend. Both appeared languid; and from the margin of one, two tentacula

* Condensed in Dr. Johnston's Brit. Zooph., 239.

appear sprouting. They hang in a very flaccid state, so that I could not examine the condition of the mouth yesterday (the first of their separate existence); but to-day one exposes his mouth, which is perfectly formed. One seems to have lost, to a great extent, if not entirely, the prehensile power of the tentacula, which neither grasp nor stick. The other is in a more normal condition, but still weak."

Lucernaria auricula. The Auricled Lucernaria.

A specimen of this species, about half an inch in height, was given me by Mrs. Brett. It was of a dark, brownish-red hue, sub-pellucid, so as to show indications of the pale ovaries within. The clusters of tentacles were more rosy in tint. These consisted of rather short stalks, with slightly larger globose heads, about forty in each cluster. The animal was strongly contracted when brought to me, the arms bent inward, and the tentacle-clusters in close contact; it remained in this condition, without movement of any kind. The auricles were oval, of a light green; possibly these organs may be analogous to the marginal azure tubercles in *Actinia mesembryanthemum.*

The Frontispiece represents three species of *Sagartia.*

In the left-hand corner is an expanded specimen of *S. aurora*, the Orange-tentacled Anemone, and above it one contracted.

In the centre of the foreground are three specimens of the Rosy (*S. rosea*); one contracted, and two expanded.

At the right-hand is the Snowy-disk (*S. nivea*), both expanded and contracted.

In Plate XXIII., figs. *a* and *b* represent the Orange-disk (*S. venusta*); the former contracted, the latter expanded.

Fig. *c* is the Glaucous Warty Anemone (*Bunodes thallia*), partially open.

APPENDIX.

I. (Page 258.)

ENCROACHMENTS OF THE SEA.

The evidence for the inundation mentioned in the text has been collected with much care and industry by the Rev. G. Edwards, of Llangollen, and published in a valuable Memoir read before the Cambrian Archæological Association, at Caernarvon. I shall crave the liberty of citing it entire.

"*The Inundation of Cantre 'r Gwaelod, &c.*

"There is a tradition in the surrounding country, that the sea at some distant period came in and overwhelmed an extensive territory called 'Cantre 'r Gwaelod,' or the Lowland Hundred, upon the western coast of Wales. And this tradition is corroborated by the testimony of several ancient records, both in prose and poetry, still preserved in the Welsh language. The Lowland Hundred, it is said, occupied a great part of the bay which is now called Cardigan Bay; and a straight line drawn from Bardsey Island, on the coast of Caernarvonshire, to Ramsey, in Pembrokeshire, would probably show the extent of land lost when this calamity took place. The time assigned to the event is differently stated in different records; for, according to some accounts, it happened as early as A.M. 3591; but, according to others, it took place in the fifth century. But all the documents on the sub-

ject coincide in proving the event, though they differ as to the date and extent of the inundation. This circumstance, however, may, in some degree, be overlooked, when we consider that the event is alluded to by historians, bards, and antiquaries, who have written at different periods. The person mentioned as the main cause of the disaster was Seithenyn, son of Seithyn Seidi, prince of Dyfed, or Dimetia, a part of South Wales. He, it is said, had the care of the flood-gates which prevented the sea from coming in at high water. The land being low, a sort of embankment, or wall, had been raised to prevent the sea bursting in and overflowing it; the flood-gates, probably, were upon some part of this embankment where the rivers discharge themselves into the sea, and it was necessary to close them at high water; and upon one night of feasting and mirth, when the inhabitants were buried in sleep and wine, and Seithenyn among the rest, the flood-gates were left open, and the sea burst in upon the inhabitants, many of whom were buried beneath its waves whilst revelling at their banquet, and leading in the dance; and their songs of joy were turned into a midnight cry. Some accounts say that Seithenyn himself, in his drunkenness, went and opened these flood-gates, and thus intentionally caused the lamentable catastrophe. In the Triads, which are a collection of very ancient historical records in the Welsh language, this Seithenyn is called one of the three great errant drunkards of the Isle of Britain. The circumstance is thus recorded in the Triads:—

"'Seithenyn the Drunkard let in the sea over Cantre 'r Gwaelod, so that all the houses and lands contained in it were lost. And before that time there were found in it sixteen fortified towns, superior to all the towns and cities in Wales, except Caerlleon on the Usk. And Cantre 'r Gwaelod was the dominion of Gwyddno, king of Cardigan; and this event happened in the time of Am-

brosius. And the people who escaped from that inundation came and landed in Ardudwy, the country of Arvon, the Snowdon mountains, and other places not before inhabited.'

"Such is the testimony of the Triads. And as to the authority of these ancient records, it should be here observed that the Druids, among the Britons, did not commit their precepts and records to writing, but delivered them in a form most likely to be remembered; and the triad was a form peculiarly adapted for this purpose, where the number of circumstances is neither too few to make an impression, nor too many to be clearly and strongly engraven on the memory. Thus the ancient Druids and bards transmitted the principles of history and science to their disciples; and these Triads being only commemorative of facts, the dates of those facts can only be known from internal, or concurrent, testimony.

"In the Myvyrian Archæology there are some poems attributed to Gwyddno Garanhir. They are certainly very old, and were probably written as early as the sixth or seventh century. One of them is written upon the inundation of Cantre 'r Gwaelod. The author calls upon Seithenyn the Drunkard to stand out and see what he had done. The following may be considered as containing the meaning of some parts of the poem:—

"'Seithenyn, come out, and look towards the abode of heroes: the plain of Gwyddno is overwhelmed by the sea. Cursed be the embankment which let in, after wine, the open fountain of the roaring deep! Cursed be the keeper of the flood-gates, who, after his festive mirth, let in the fountain of the desolating ocean! The sound of the western wave from the summit of the embankment—let this be raised to God. After plenty often follows endless ruin. The sound of the western wave from the height of the wall—God is to-day implored. Want often follows after pride. The sound of the western wave troubles me to-night—I have no easy prosperity. After too much presumption often cometh a fall. The sound of the

western wave invites me to-night to leave my abode. After arrogance often cometh lasting ruin.'

"Another old poem upon the same subject, which is published in Meyrick's 'History of Cardiganshire,' together with a translation, gives a much earlier date to this event than the one mentioned in the Triads. It says it took place in the time of Gwrgant Farfdrwch, viz., about A.M. 3591, as before stated. Many circumstances lead me also to think it must have happened at a much earlier period than in the fifth century; for if it had taken place as late as that time, there would have been found a better and more circumstantial account of it, connected with the history of Wales during that period; and we find nothing in the geographical description of the country in the time of the Romans likely to lead us to form an opinion that any great extent of land, or any towns of importance, existed in their time where Cardigan Bay now lies. We find no trace of any extensive territory situated there in the Itinerary of Antonius, of Ptolemæus, or in the works of Richard of Cirencester. And it is not likely, if such an extensive territory and so many towns existed there during the Roman period, that they would have left them unnoticed; therefore, we may reasonably conclude, that the inundation happened at some period before the Christian era.

"Many traditions connected with this calamity are, I have been informed, related to this day in some of the districts bordering upon Cardigan Bay; and it would be difficult to account how these traditions could have been handed down from age to age, without supposing that a large tract of land, once the abode of men, was at some distant period swallowed up by the sea. A proverb is often made use of among the inhabitants of these parts, when any great calamity befals any person:—

"'Ochenaid Gwyddno Garanhir,
Pan droes y don dros ei dir.'

"'The sigh of Gwyddno Garanhir,
When the wave came over his land.'

And it has a reference, no doubt, to the inundation of Cantre 'r Gwaelod. About two leagues to the east of Cardigan Isle is Cribach Road, where, according to tradition, there was a town before the inundation; and this town, it is said, was much frequented by the inhabitants of Gaul. Bardsey Island at one time belonged to Pembrokeshire, and paid its taxes to it—amongst others, a county rate of fourpence. Some superstitions peculiar to that country, such as the superstition of the corpse-candle, and others, are also found in the southern part of Caernarvonshire.

"Several high ridges, resembling the remains of some old embankments, are still visible, at low water, in Cardigan Bay, and may be traced a long distance into the sea. One of them, called Sarn Badrig, may be traced for twenty-one miles, and is often dry for nine miles when the water is low. This is generally supposed to be some remains of the embankment raised to prevent the sea from overflowing the country; and at the end of it there are sixteen large stones, one of which is four yards in diameter. 'Sarn Badrig,' says Mr. Bingley, 'is a stone wall which runs out into the sea from Mochras, a point of land a few miles to the south of Harlech, in a south-west direction, for nearly twenty miles; it is a wonderful work, being throughout twenty-four feet thick.' But Mr. Lewis Morris says that it is a ledge of rock, very narrow, and steep on the north side, but with regular soundings on the other side. There is a similar ridge, but not so long, called Sarn Cynfelyn, near Aberystwyth. This reaches seven miles into the sea; and close to the

termination of it are found some ruins like the remains of old walls, which are called Caer Wyddno, or Gwyddno's fortification; and it is supposed that the royal palace once stood here, and the seat of Gwyddno Garanhir. Some persons say that these ridges are nothing more than beds of solid rock, extending into the sea in various directions, and covered with sand. But others affirm in reply that the embankments were built upon these rocks, and that some portions of the walls are found to this day under the sea. There are three other ridges similar to the above, but not so long, to be seen at low water in other parts of Cardigan Bay. Sarn y Bwch, near Aberdysyni, in Merionethshire, extends about a mile and a half into the sea; Sarn Dewi, near St. David's, Aberarth, extends about a quarter of a mile; and Sarn Cadwgan, about a mile from the above, is about a mile and a quarter in length.

"If it were possible to collect all the traditions respecting the inundation of Cantre 'r Gwaelod, which are scattered amongst the inhabitants of the surrounding country, these might throw considerable light upon the subject; and if it were possible, also, to examine those ridges already described, in order to ascertain whether the hand of man has been at work in the formation of any part of them, or not, such an inquiry would amply repay the labour and research of the antiquary and the archæologist. There are many other indications along the coast in these parts that the sea, in days gone by, has encroached upon the land. Remains of large forests have been discovered in various parts, extending a long distance into the sea, and the marks of the axe were distinctly seen upon some of the trees thus found. Not many years ago, a considerable number of large oak-trees were discovered under the bed of the sea near the mouth of the

river Dysyni: one of these trees measured six feet in diameter.

"All the southern parts of the coast of Merionethshire exhibit strong indications of the progressive state of the sea in the vast banks of peat which extend along the coast, towards Towyn, and reach to an unknown distance into the water. The same thing may be said also, of the coast of Pembrokeshire. One circumstance is mentioned in an old MS. written before the time of Camden, and published in the *Cambrian Register*, worthy of notice in this place. The writer says:—

"'Another rare and strange thing is to be remembered of certain roots of trees, which, about twelve or eighteen years past, were seen on the sands at Newgal; by reason it seemeth that the violence of the sea, or some extreme flood of the rivers in winter, washed away the sand which is daily overflown with the tide, that there appeared in the sand infinite numbers of the butts of trees, in the places where they had been growing, and there appeared the very stroke of the hatchet at the falling of those trees. By this it appeareth that the sea in that place hath intruded upon the land. This thing Giraldus Cambrensis, who wrote his description of Wales in the time of Henry the Second, noteth; for, in his time also, these butts of timber were seen, and he layeth it as a strange memorial to posterity.'

"Camden's testimony confirms the above, when he says:—

"'We may gather from the words of Giraldus, that Cape St. David's once extended further into the sea, and that the form of the promontory has been altered. When Henry the Second was in Ireland, by reason of an extraordinary violence of storms, the sandy shores of this coast were laid bare, and the face of the land appeared, which had been covered for many ages. Also the trunks of trees which had been cut down, standing in the midst of the sea, with the strokes of the axe as fresh as if they had been yesterday, with very black earth, and several old blocks like ebony; so that it did not appear like the sea-shore, but rather resembled a grove—by a miraculous metamorphosis, perhaps ever since the time of the

Deluge, or long after, at least very anciently—cut down, and consumed, and swallowed up by degrees, by the violence of the sea continually encroaching upon, and washing off, the land.'

"At a meeting of the Geological Society in 1832, a paper was read by the Rev. James Yates, M.A., F.G.S., on a submarine forest in Cardigan Bay. The forest extends along the coast of Merionethshire and Cardiganshire, and is divided into two parts by the estuary of the river Dovey, which separates these counties. It is bounded on the land side by a sandy beach and a wall of shingles. Beyond this wall is a tract of bog and marsh, formed by streams of water, which are partially discharged by oozing through sand and shingles. As the position of the above wall is liable to change, it may have at one time enclosed the part which is now submarine. The remains of the forest are covered by a bed of peat, and distinguished by an abundance of *Pholas candida* and *Teredo navalis*.

"There are likewise many proofs of the advancement of the sea along the coast to the north of Cardigan Bay. When the Roman army, under Suetonius Paulinus, invaded the Island of Anglesey, the cavalry crossed the Menai Strait, partly by swimming over, and partly by fording it, according to Tacitus's account. The place where the Romans crossed over the Menai is said to be near Porthamel; and now the river is about half a mile broad there at low water, and many fathoms deep. And, near the same place, Agricola and his forces crossed over, fifty years after Suetonius; when, as we learn from the same author, the infantry and cavalry swam over and forded the river, having first gained information from the inhabitants, who were well acquainted with the fords, as to the method in the country of swimming over such places; but, at present, it would be impossible to cross

over any part of the Menai in the manner described by the Roman author.

"There is a tradition similar to the one respecting Cantre 'r Gwaelod, that the whole of that range of sand which extends from the vicinity of Beaumaris towards Great Orme's Head, and called Traeth y Lafan, was overwhelmed by an inundation, and that it was then the estate of one Helyg ab Glanog, who lived at a place called Dol Helyg, in that neighbourhood. This calamity, like the foregoing one, is said to have come upon the place unexpectedly during a great feast in the house of Helyg ab Glanog. When the guests were carousing, and calling for more wine, the harper was suddenly struck with amazement, as his spirit foresaw the coming evil. And the servant, who had gone down to the cellar for wine, rushed wildly into the hall, crying out, 'The tide! the tide!' The harper and the servant alone had time to escape, and found safety in the mountains; all the rest were swallowed up,—lands, flocks, and houses,—by the impetuous torrent.

"'A vast extent of inhabited country is supposed to have been overrun by the sea to the north of the town of Abergele; and, as a proof of this, we may cite an epitaph in the Welsh language, without a date or a name, stating that the person to whose memory the monument had been erected lived three miles to the north; but three miles to the north of the town of Abergele would now extend a long distance into the sea. Many other testimonials might be added, both from ancient records and traditions, to show that the sea has encroached upon the land on the western coast of Wales. But if the geological evidences could be examined along the whole line of coast, from Pembrokeshire to the estuary of the Dee, I think much light would be thrown upon what has been already stated of the inundation of Cantre 'r Gwaelod."

II. (Pages 356, 361.)

THE SUBDIVISION OF THE GENUS ACTINIA.

In the preceding pages I have used the names *Sagartia* and *Bunodes* for certain species of the Sea-Anemones. These generic appellations were instituted in a paper which I read before the Linnean Society, March 20th, 1855, and which is published in the Linnean Transactions for that year.* As the Memoir may not be readily accessible to many of my readers, I shall take the liberty of making some extracts from it :—

"Restricted as is the genus *Actinia*, by the separation from it of *Adamsia* and *Anthea* among British, of *Metridium* and *Actinecta*, and many others, among exotic species, and by the creation of such genera as *Capnea*, *Corynactis*, *Ilyanthus*, &c., it is still so immense a group that any subdivision of it on sound principles is desirable ; especially when we consider the great difficulty of defining species in this tribe. Indeed, I hold that wherever we find *several* characters *coexistent* in a certain number of species, none of which are common to other species, the species possessing such characters ought to be elevated to the rank of a separate genus.

"Applying these principles to the group before us, I find a number of *Actiniæ*, which have the well-marked character of projecting from pores in the exterior of the body, whenever they are irritated, thread-like filaments,

* "On *Peachia hastata*;" Linn. Trans. for 1855 ; p. 267.

in great abundance and to great length, which are again withdrawn into the body. These filaments, when examined with a high power, are seen to be chiefly composed of thread-capsules, or 'nettling-organs;' and I have given elsewhere * evidence to show that their function is that of efficient weapons of offence, paralysing even vertebrate animals, with which they are brought into contact. Every one who has handled *A. parasitica*, *venusta*, or any of the species with missile threads, is aware of the great tenacity with which these filaments adhere to the fingers. This is owing to the penetration of the epidermis by the myriads of ejected threads, and to the hold which their barbed structure enables them to retain. For when these nettling-organs are examined—say with a power of 500 diameters — the thread is perceived to be armed in a manner which gives them a superiority over those of all the non-shooting species; and thus the structure of these organs affords us another excellent and constant generic character. There are, indeed, in these species always to be found many thread-capsules of the ordinary form and structure, viz.: linear-oblong, emitting a thread which is apparently simple, and of great length, extending to about twenty times the length of the capsule. But the principal portion of the capsules are of another form, being long-oval, with a distinct longitudinal chamber, and emitting a thread never exceeding thrice the length of the capsule, and more commonly one or one-and-a-half times. The terminal portion of this thread (including from half to more than three-fourths of its length, according to the species) is barbed with close-set bristles, radiating on all sides, like the hairs of a bottle-brush, and more or less reverted. In *A. venusta*, a zigzag lineation is discernible on the thread, which seems to indicate that

* Devonshire Coast, *passim;* Aquarium, pp. 115, 143, 148.

the hairs are set on in a spiral arrangement. Before emission, the thread-chamber is very distinct in this species, running through the whole length of the capsule, slightly bent in a sigmoid curve, and gradually merging into the capsule-walls at the discharging end. In some instances, a thread is discharged, in every respect agreeing with that just described, but perfectly simple and without barbs. I think that this occurs when the emission has been very slow; that the barbed hairs fly out only when the missile force is sudden; that otherwise they continue appressed to the sides and invisible. I can discover no trace of the spiral in the unemitted thread.

"This brush-like form of the nettling-thread I find in ten of our native species of *Actinia*, (which I shall presently enumerate,) invariably coexistent with the power of emitting filaments spontaneously. They are marked also by other characters of less importance, because less definite:—the tentacles are generally of small size, slender, numerous, and much crowded; the body is soft, rarely coriaceous, and smooth, though commonly perforated with sucking glands, which are distinct from the emitting-pores; and the colours of the body often have a tendency to run in longitudinal bands, and those of the tentacles to form arrow-heads. The genus thus characterised I propose to call *Sagartia*.*

"The remaining British species (for I beg it to be observed that I am speaking only of such as I have had opportunities of personally examining) may be distributed

* "There is a certain nomadic race, called Sagartians. . . . The mode of fighting of these men is as follows:—When they engage with the enemy, they throw out ropes, which have nooses at the end; and whatever anyone catches, whether horse or man, he drags towards himself; and they that are entangled in the coils are put to death."—*Herodotus*, vii. 85.

into two groups. The first contains such species as have the body studded with warts, the skin coriaceous, the tentacles moderately few, generally thick, conical, and obtuse, and for the most part marked on their facial surface with transverse dashes of opaque colour. They do not discharge filaments under any annoyance (when wounded, however, the convoluted ovarian bands protrude); and the nettling threads of their tissues are long and simple, or at least never brush-like. That of *A. crassicornis*, indeed, is armed at its *base*, as I have represented it elsewhere;* but it is in a manner peculiar to itself, and totally unlike that of the *Sagartiæ*. This fine species deviates in some other subordinate particulars from the rest of the verrucose *Actiniæ*, and may possibly require ultimately to be separated. For the present, however, I include it in this genus, which I propose to call *Bunodes*.†

"There now remains a group, for which, as it includes the most abundant of our species, the everywhere-familiar Smooth Anemone (*A. mesembryanthemum*), I would retain the appellation of *Actinia*. In addition to this well-known species, we have two others on the British shores, which I shall presently mention. Besides the negative characters which mark this species,—the absence of emitted filaments, and of surface-warts,—they have a distinct positive one in the existence of a series of spherical or oval bodies of unknown function, seated between the outermost row of tentacles and the margin of the disk. In our native species, these are conspicuous from their opaque blue or white colour; but, in exotic species, they occur of other hues. In *mesembryanthemum*, the ovarian bands and the walls of the tentacles are furnished with comparatively few thread-capsules, which are linear and very small;

* Devonshire Coast, pl. xxviii. fig. 19.

† Βουνώδης, verrucosus, clivosus.

those of the bands being about $\frac{1}{700}$th of an inch in length, and those of the tentacle-walls not more than $\frac{1}{1200}$th; whereas the ovate capsules of the *Sagartiæ* run from $\frac{1}{350}$th (*dianthus*) to $\frac{1}{813}$th (*parasitica*); the length in most of the species being about $\frac{1}{300}$th.

"The marginal spherules, however, are [as I have before stated, p. 370, *ante*] almost wholly composed of capsules. From these facts, I incline to think that the marginal spherules of *Actinia* may represent, in function, the missile filaments of *Sagartia*.

"Among subordinate characters of this genus may be mentioned the very delicate and smooth skin, destitute of both pores and sucking glands. The disk and tentacles are unicolorous, as is also the body generally, though this is sometimes varied by lines or spots of another colour, which are by no means constant; a line of different hue more commonly encircles the base. The tentacles are moderately numerous, of medium thickness, tapering to a point.

"These three genera may be therefore defined thus:—

"1. *Sagartia* (mihi). *Actiniæ* with adhering base, with conical, readily retractile tentacles; without marginal spherules; body destitute of warts, emitting capsuliferous filaments from pores; nettling-threads short, densely armed with a brush of hairs. British species, *viduata* (= *anguicoma*, Price), *troglodytes*, *aurora*, *candida*, *rosea*, *nivea*, *venusta*, *parasitica*, *bellis*, *dianthus*. Probably also *aurantiaca*, and *pulcherrima* of Professor Jordan. The following exotic species, figured by Dana, in the Zoophytes of the American Exploring Expedition, seem to be referrible to this genus:—*primula*; the beautiful *decorata*, and *Fuegensis*, both allied to our *bellis*; and *Achates*, *reticulata*, and *Paumotensis*,--perhaps the most magnificent of the whole tribe,—which are evidently allied to *dianthus*.

"2. *Bunodes* (mihi). Without marginal spherules; body studded with warts; skin coriaceous; without missile filaments;—nettling-threads long and simple: tentacles, generally, thick, conical, and obtuse.

"British species, *gemmacea, thallia, clavata, crassicornis, monile* (probably the young of *thallia*)?; *chrysoplenum?, alba?, miniata?* Of exotic species, *diadema, pluvia, gemma, artemisia* of Dana's Zoophytes, probably come here.

"3. *Actinia* (Linn.). A series of capsuliferous spherules at the margin of the disk; body destitute of warts, pores, and missile filaments; skin smooth.

"British species, *mesembryanthemum; margaritifera, chiococca.* Exotic species, *tabella,* and *graminea* of Dana.

"The following British species are of doubtful place:—*coccinea, intestinalis, biserialis, vermicularis.* The very curious *biserialis* of the late lamented Professor Forbes, has a close parallel in the *rhodora* of Dana; and these may perhaps form another genus, when more is known about them. *Intestinalis* and *vermicularis,* both from the Shetland seas, show, in their slender, lengthened form, an approach to the free condition of *Peachia,* &c. The latter of these is a deep water species (80 fathoms), and, as Professor Forbes observes, looked, when unattached, 'more like a planarian worm than an *Actinia.*'

"If we take *Sagartia* as the typical genus, which its superior populousness and the perfection of its armature entitle it to be considered, we may trace, as from a central point, some of the relations of the *Actiniadæ* with other forms. *Adamsia* comes very close to *Sagartia,* possessing the power of emitting filaments in high perfection; probably the point of union between these genera will be *S. parasitica,* which, like *Adamsia palliata,* attaches itself to shells in which *Paguri* dwell, and which is preeminent

in its genus for the abundance and the tenacity of its filaments. The passage from *Sagartia* to *Bunodes* is perhaps through *S. dianthus* and *B. clavata;* the disk of the latter being very expansive, with the tentacles situated at its margin. *S. bellis*, in its power of assuming a saucer-like form for its thin expanded disk, to which the narrow body serves as a foot-stalk, shows also a remote approach to *Lucernaria*, in which this figure is permanent.

"*Lucernaria* exhibits a beautiful link of connexion between the Actinoderm and the Arachnoderm forms of RADIATA. The *Oceania turrita* has its umbrella produced into a long moveable spire, which looks exactly like a footstalk, by which it had been attached when in a polype condition; while, in *Bougainvillæa*, we get the numerous tentacula gathered into groups. The mobile four-lobed mouth of *Lucernaria* closely resembles the peduncle of a Medusa.

"There is a curious analogy (I fear it is nothing more) between *Lucernaria* and the genus *Flosculuria* among the ROTIFERA. Both are attached by a slender pedicle, both have a flower-like disk, jutting out into angles, which are beset with a multitude of filaments (tentacles in the one case, setiform cilia in the other), that radiate in all directions.

"The tender and soft-bodied little *Sagartia candida* seems to lead off to *Corynactis Allmanni*, though the points of resemblance are rather general than special. But this latter genus passes into *Capnea* by a remarkable species described by Mr. W. Thompson of Weymouth, in the Zoological Transactions for 1853, under the name of *Corynactis heterocera*, and which I had an opportunity of examining while alive. Professor Forbes has observed the close affinity of his *Capnea sanguinea* to the *Zoanthadæ;* and the transition which the latter exhibit to the creeping

and budding Hydroid polypes is sufficiently apparent. *Corynactis*, in its capitate tentacles, shows also a relation to *Cyathina Smithii* among the coralligenous ANTHOZOA; while the simply conical form of these organs in *Balanophyllia regia* agrees with *Actinia*, &c.

"The transition from *Sagartia* to *Actinia* proper, I do not know how to trace, except by characters common to the whole group. The soft-bodied species of the former genus, which do not possess sucking-glands—as *candida*, *venusta*, and *nivea*—are certainly more closely allied to the smooth-skinned *A. mesembryanthemum* than such coarse species as *S. bellis*, *parasitica*, &c.; and this is all I can say.

"I think, however, that *Actinia* makes a decided approach to *Lucernaria* in the capsuliferous spherules of the margin; for the oval appendages, which are placed on the edge of the disk in the latter genus, alternating with the groups of tentacles, are, I doubt not, consimilar in structure and function to those spherules.

"The nearest alliance of *Anthea* is with *Actinia*, to which, in the texture of its skin, and the absence of warts, pores, and glands, it presents a close resemblance. The received notion that *Anthea* is incapable of entire retractation, I have elsewhere stated to be incorrect; and I have since had several opportunities of seeing it with the tentacles quite concealed, and the animal assuming the ordinary button-like shape of an *Actinia*. A better character is the tendency which the tentacles have to form groups, like several trunks of a tree united close to the ground. In this respect, there is perhaps an approximation to *Lucernaria*; remote, however; for the clusters thus formed are still in contiguity with each other, and the peculiarity cannot be discerned, except when the animal is in the state of widest expansion."

"Finally, the species *viduata* appears to be the point at which the genus *Sagartia* leads off towards the ECHINODERMATA. Though in an Aquarium it remains attached for months together, yet in freedom its adhesion is evidently very slight. It comes on shore by hundreds after a gale on the Devonshire coast, and is frequently dredged on sandy mud, sometimes adhering to a small bivalve shell, but more commonly free, with the posterior extremity contracted, so as to resemble a thick pedicle. It burrows in sand; and, in conformity with such a habit, it has the power of great elongation. A specimen which I have kept for the last six months, sometimes forms a slender column five inches in height. From this vermiform creature the transition is so brief to the free *Ilyanthus*, that we hardly need to seek a place for *intestinalis* and *vermicularis;* and from *Ilyanthus* to the genera *Peachia* and *Edwardsia*, of which I have spoken in the former part of this Memoir, and thence to the *Sipunculidæ*, the road is patent."

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